CONTROL DATA®

MODEL 3290-D DISPLAY EQUIPMENT

- General Description
- Operation
- Programming



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HARDWARE REFERENCE MANUAL

MODEL 3290-D DISPLAY EQUIPMENT HARDWARE REFERENCE MANUAL

SECTIONS IN THIS MANUAL:

Section I — General Description

Section II — Operation

Section III — Programming

Any comments concerning this publication should be addressed to:

Control Data Corporation Technical Publication Department 2401 North Fairview Avenue St. Paul, Minnesota 55113

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FOREWORD

This manual contains information to guide personnel in operating the CON-TROL DATA Model 3290-D Display Equipment. This manual explains the operation of the display equipment from a user's point of view and bridges the gap between the more detailed customer engineering publications for each device.

Discussion in this manual is arranged in three basic sections. A brief outline of each section follows:

Section I, General Description — contains functional, operational, physical descriptions, and electrical data.

Section II, Operation — lists controls and their functions and explains operating procedures through use of the controls.

Section III, Programming — gives programming aspects of the display equipment. Information is provided on function codes, status codes, interface signals, word formats, etc.

For a more detailed description of the equipment described herein, reference the Model 211-G, H, J, K, L, P Display Station Reference/Customer Engineering Manual (publication number 82117800), Model 218-F, G Printer Station Reference/Customer Engineering Manual (publication number 82132900), and Model 3290-D (with 215-B Poller and including Option 10033-C) Customer Engineering Manual, Books 1 through 4 (publication numbers 82123000, 82123100, 82135600, 82123200, and 82123300, respectively).

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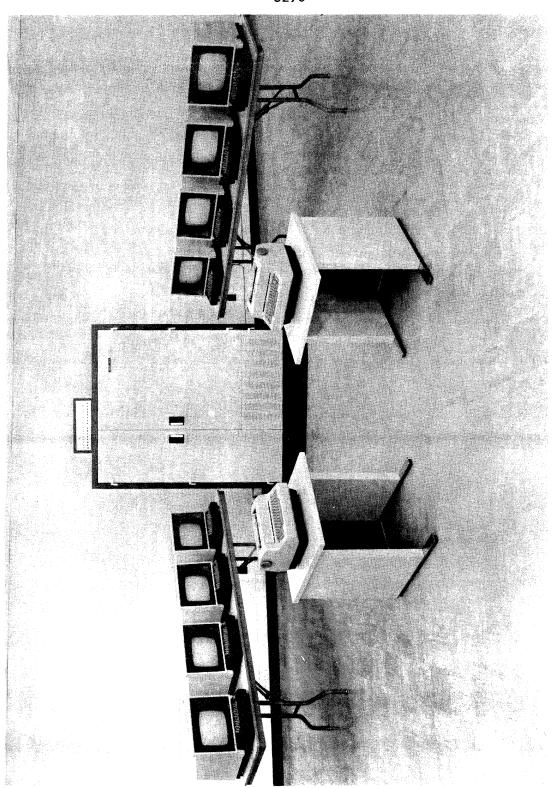


Figure 1–1. Typical Set of Display Equipment

SECTION I

GENERAL DESCRIPTION

The display equipment, designed for use with a CONTROL DATA 3000 Series computer, consists of a Display Controller and a combination (not to exceed 12) of Display Stations, Printer Stations, and pollers.

A typical set of display equipment is shown in figure 1-1. The display equipment provides access to data storage and computational capabilities of a central computer complex by means of inquiry and retrieval Display Stations. To obtain hardcopy records of displayed messages, transfer data to an associated off-line Printer Station. The poller allows communications between the computer and remote sites.

The Display Stations and/or Printer Stations may be located as far as 1000 feet from the Display Controller. A Display Station and its associated logic circuitry must be employed for every Printer Station used; however, one Printer Station may serve more than one Display Station. The poller assembly controls communications between the 3000 Series computer and a remote terminal Display Controller. Communications between the poller assembly and the remote Display Controller take place over conventional phone lines utilizing a DATA-PHONE* Data Set 201A or 201B.

OPERATIONAL DESCRIPTION.

Data is entered on the Display Station 14-inch (diagonal measurement) cathode ray tube (crt) screen from the computer at an approximate rate of 50,000 symbols per second and from the Display Station keyboard at operator typing speeds. Standard display format is 20 lines of 50 symbols per line within a nominal 8-inchwide by 6-inch-high raster area. An optional display format is available with 13 lines of 80 symbols per line.

Symbol intensity is adjustable and the P4 phosphor-coated crt makes displays clearly legible in normal office lighting. Data presented on the display screen is refreshed at a flicker-free rate of 50 cycles per second. Symbol dimensions are nominally 1/8-inch wide by 1/4-inch high.

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^{*} Trademark of AT&T

An entry marker, displayed as an underline, conveniently indicates to the operator where the next symbol will appear. The entry marker can be positioned anywhere within the 8 by 6 inch viewing area and moves automatically across the page as each symbol is typed, or inserted by the computer. At the end of a line, the entry marker automatically moves to the first symbol position in the next line down. When it reaches the end of the last line on the page, it automatically moves to the first symbol position in the upper left corner of the screen.

Positioning the entry marker at the end of the print message and depressing the keyboard PRINT key transmits displayed messages to an associated Printer Station. Data from the top of the screen to the entry marker position is transmitted to the Printer Station and typed out at the rate of 15.5 symbols per second on continuous strip paper 9-7/8 inches wide and perforated for folding and tearing at 11-inch intervals.

FUNCTIONAL DESCRIPTION.

The remainder of Section I describes in more detail primary Display Controller, Display Station, and Printer Station functions.

The Display Controller consists of an interface, central control and symbol generator assembly, station driver assemblies, printer driver assemblies, and may contain up to two poller assemblies. On diagrams and some figures the central control and symbol generator assembly is referred to as CBU, station drivers as SDU's and printer drivers as PCU's.

The interface enables Display Controller communications with a 3000 Series computer. Two cables (up to 200 feet long), identified as "A" and "B", provide the data link between the computer and Display Controller. Twisted-pair signal lines, contained in cables A and B, are described under interface signals in Section III.

Symbol generation, timing, and data flow gating logic are contained in the central control and symbol generator assembly. Video pulse trains, representing symbols, are developed in the symbol generator. These pulse trains are made available to each station driver. The station driver selects the proper pulse train and transmits it to the crt where it is displayed by unblanking the beam in a 5 by 7 dot matrix. Symbol dimensions are, nominally, 1/8-inch wide by 1/4-inch high. Each station driver contains logic circuitry controlling the operation of a Display Station. It receives data from the Display Station keyboard and the central control symbol generator assembly. All data sent to the station driver is stored in an associated

10-millisecond magnetostrictive delay-line memory. All stored data is assembled and decoded in each station driver, fed to the Display Station, and displayed on the crt. The display remains visible as long as stored data is continually refreshed on the crt. Figure 1-2 is a functional diagram of the Display Station.

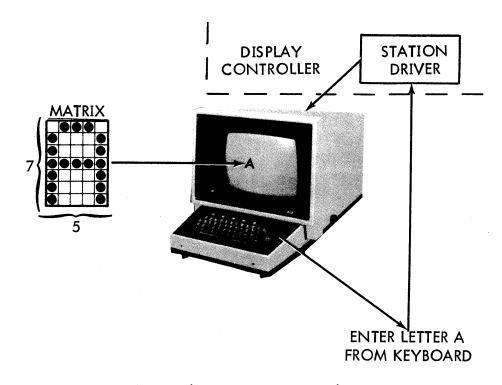


Figure 1-2. Display Station Functional Diagram

One symbol requires 16.8 microseconds to display while one line is displayed in 991.2 microseconds. Twenty lines of 50 symbols, therefore, require 19.824 milliseconds allowing 9 symbol times for horizontal retrace. Thirteen lines of 80 symbols require 19.437 milliseconds.

A printer driver contains the Printer Station control logic. Data from the station driver assembly register is translated and sent to the printer driver. Printer control and priority control logic are in the printer driver. One Printer Station can serve as an output device for up to 10 Display Stations if one poller is used or it can be used for an output device for up to 9 Display Stations if two pollers are used.

Each Printer Station contains a Selectric * typewriter; depressing the PRINT key at a Display Station activates the typewriter. If the PRINT keys at several Display Stations associated with a Printer Station are depressed while the Printer Station is busy printing, the requests are processed in order of lowest Display Station number. Type set is designated "Data No. 1" ** and type spacing is 10 symbols per inch in a line with 6 lines per inch. The printer uses a black fabric ribbon to type symbols on a 9-7/8-inch-wide continuous strip paper. The paper is perforated for folding and tearing at 11-inch intervals. Feed holes are 9-3/8 inches apart and spaced 1/2 inch in the longitudinal direction.

Printout is accomplished at the following speeds: print one symbol, 64.5 milliseconds; carriage return, 129.0 milliseconds; shift, 64.5 milliseconds; and space, 64.5 milliseconds.

The Display Controller may contain a maximum of two pollers. Data is sent to or from the remote stations via the poller in 8-bit serial codes. The Data Set synchronizes all received or transmitted data. A poller controls the remote site's requests to transfer data by periodically polling (scanning) them in sequential order.

ENVIRONMENTAL CONDITIONS.

The Display Controller operates at normal room temperature but has a blower assembly housing located beneath the logic chassis assemblies for specific cooling of the logic chassis. The Display Stations and Printer Stations also operate at normal room temperature but are cooled by radiation and convection. Tables 1–1 through 1–3 list specific environmental limitations for all three units.

PHYSICAL DATA.

The display equipment configuration may consist of no more than 12 Display Stations, Printer Stations, and pollers. No more than two pollers may be employed, so the maximum display equipment configuration that would be possible locally would be a combination of ten Display Stations and/or Printer Stations with two pollers. The pollers are capable of communicating with up to 16 remote Display Controllers. Refer to figure 1–3.

^{*} IBM Trademark.

^{**} IBM Classification.

TABLE 1-1. DISPLAY CONTROLLER ENVIRONMENTAL CONDITIONS

CONDITION	OPERATIONAL Normal/Standby	NONOPERATIONAL Storage/Transit (Note 1)
Temperature	+65 F to +85 F	- 30 F to + 150 F
Relative Humidity	10 to 90%	0 to 100% (Note 2)
Altitude	- 1000 to + 10,000 feet	- 1000 to + 15,000 feet
Note 1 — packed for shipment. Note 2 — includes condensation in the form of moisture or frost.		

TABLE 1-2. DISPLAY STATION ENVIRONMENTAL CONDITIONS

	ncludes condensation in r frost.	the form of moisture
Note 1 — p	acked for shipment.	
Altitude	8,000 feet	12,000 feet
Relative Humidity	40 to 60%	10 to 90% (Note 2)
Temperature	+65 F to +100 F	- 65 F to + 160 F
CONDITION	OPERATIONAL Normal/Standby	NONOPERATIONAL Storage/Transit (Note 1)

TABLE 1-3. PRINTER STATION ENVIRONMENTAL CONDITIONS

CONDITION	OPERATIONAL Normal/Standby	NONOPERATIONAL Storage/Transit (Note 1)
Temperature	+60 F to +100 F	- 30 F to + 150 F
Relative Humidity	10 to 90%	5 to 100% (Note 2)
Altitude	- 1000 to +10,000 feet	- 1000 to +15,000 feet
No	ote 1 — packed for shipment.	
Note 2 — includes condensation in the form of moisture or frost.		

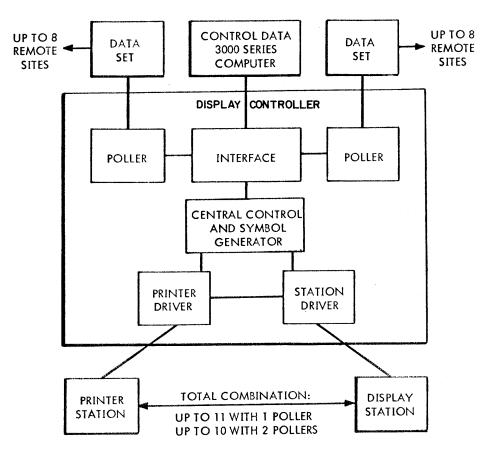


Figure 1-3. Display Equipment Block Diagram

Physical construction of the display equipment incorporates latest recognized factors in engineering, convenience, and safety to operating personnel. Figures 1-4 through 1-6 show the dimensions and approximate weight of the Display Controller, Display Station, and Printer Station respectively.

DISPLAY CONTROLLER ELECTRICAL DATA.

The Display Controller requires 57 to 63 Hz, 187 to 216 volts, 3-phase alternating current of 8 amperes. Each station driver or printer driver requires 0.4 ampere in addition to that required for the Display Controller.

Section I

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General Description

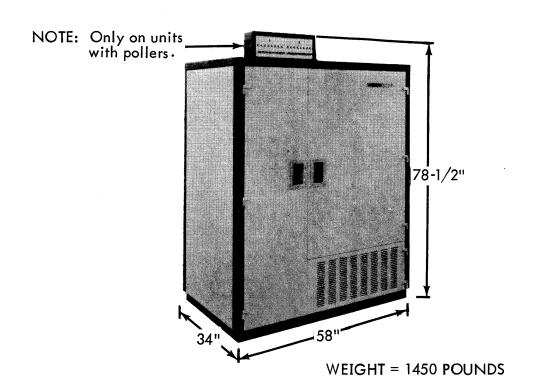


Figure 1-4. Display Controller Physical Data

DISPLAY STATION ELECTRICAL DATA.

The Display Station requires 115/230-volt, 50/60-Hz, 3-wire, single-phase power. Power expended is 130 watts with heat dissipation of 465 Btu per hour. Voltage potentials in the Display Station range from - 16 volts dc to 10 kilovolts.

PRINTER STATION ELECTRICAL DATA.

The Printer Station requires 120-volt, single-phase, 60-Hz power. It has a maximum current rating of 1.0 ampere, dissipates 400 Btu per hour, and is cooled by radiation and convection.

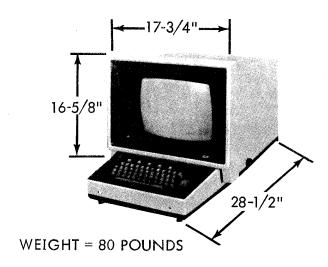


Figure 1-5. Display Station Physical Data

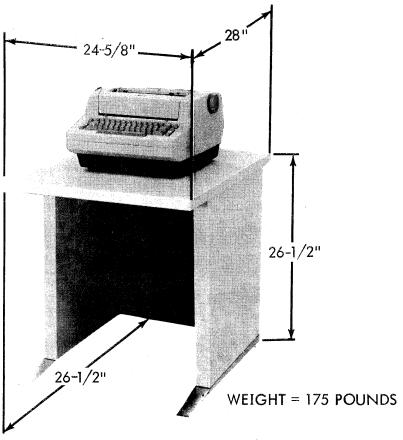


Figure 1-6. Printer Station Physical Data

Section I

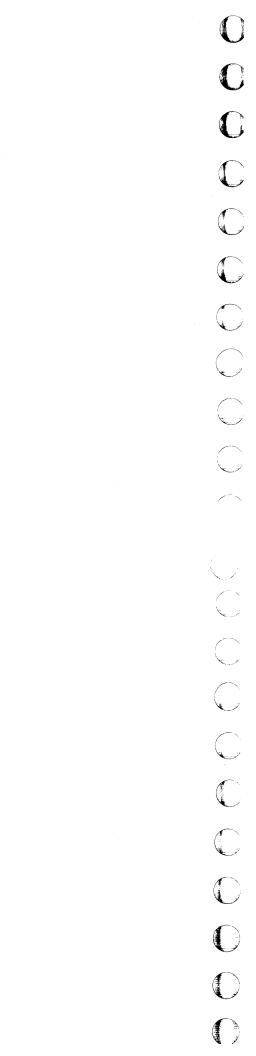
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General Description

CONVENIENCE OUTLETS.

To facilitate the use of test equipment during periods of maintenance, Control Data requires that a convenience outlet be available within 15 feet of each system component cabinet. The outlets may be located in the walls or raised floor panels and must not be obstructed by storage racks or other furniture. The receptacles shall be of the single-phase grounded type, installed according to local electrical codes. For 60-hertz installations, the nominal voltage shall be 120 volts. For 50-hertz installations, the nominal voltage shall be 220, 230, or 240 volts, as dictated by the single-phase power available at the site.

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SECTION II

OPERATION

This section contains a list of controls for operation and maintenance of the display equipment and also contains information on data inquiry, and turn on/turn off procedures.

CONTROLS.

Display Equipment controls are divided into three groups: Display Controller, Display Station, and Printer Station. Following paragraphs explain control usage within each group.

The Display Controller maintenance panel controls apply power and enable checking the display equipment operational sequence. Display Station controls apply power and adjust crt intensity. The Display Station keyboard enters data into the display equipment and controls its destination. Printer Station controls apply power to the hardcopy printer.

DISPLAY CONTROLLER.

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Figure 2-1 shows the Display Controller maintenance panel. Table 2-1 explains the callouts.

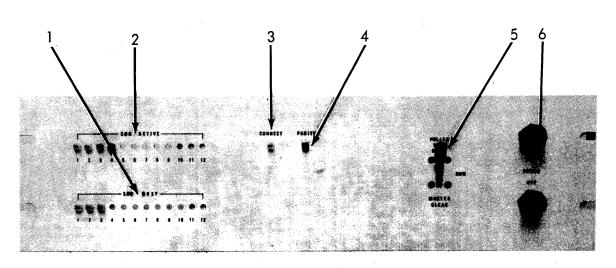


Figure 2-1. Display Controller Maintenance Panel

TABLE 2-1. MAINTENANCE PANEL CONTROLS AND INDICATORS

CALLOUT	CONTROL NAME	CONTROL TYPE	FUNCTION
1	SDU BUSY 1 through 12	Indicators white	Indicates the print busy status of each Display Station.
2	SDU ACTIVE 1 through 12	Indicators white	Indicates the input/output status of each Display Station.
3	CONNECT	Indicator white	Indicates the Display Controller is connected to the computer by a computer connect code.
4	PARITY	Indicator red	Indicates the Display Con- troller has detected a transmission parity error.
5	POLLER TEST/ RUN/MASTER CLEAR	Lever switch 3-position	POLLER TEST — allows communications between remote site and poller. RUN — enables normal Display Controller operation. MASTER CLEAR — clears Display Controller logic and all data from the delay-line memory within each station driver.
6	POWER ON/OFF	Two push— buttons	Turns Display Controller cabinet power on and off.

The auxiliary maintenance panel (figure 2-2) contains a toggle switch and a light for each of the sixteen possible remote sites (8 for each poller). The corresponding site address for each switch is labeled directly below the switch. If a switch is in the down position, the corresponding remote site receives a poll message from the poller. If it is in the up position, its site address is not polled in the poller sequence.

The indicator for each site, located directly above the switch, illuminates when a poll message is initiated to its corresponding remote site. The indicator extinguishes when the poller receives an errorless message from that site. If a particular indicator remains illuminated indefinitely, there is a communications

problem between that site and the poller. The switch corresponding to this indicator should then be placed in the up position. This will extinguish the light and remove the site from the system.

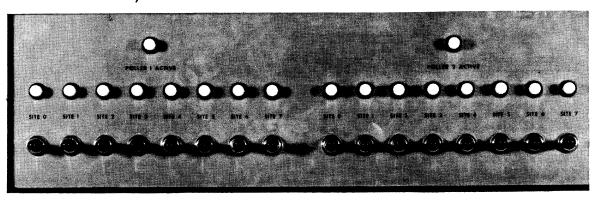


Figure 2-2. Auxiliary Maintenance Panel

Circuit breaker CB1 on the a-c control panel (figure 2-3) applies primary 208-volt, 3-phase power to the Display Controller. Also on this panel are two 120-volt ac convenience outlets and a meter, M1, which indicates the total number of hours power has been applied to the Display Controller. The six fuses located on the panel provide circuit protection for the power supplies, blower assembly, and convenience outlets.

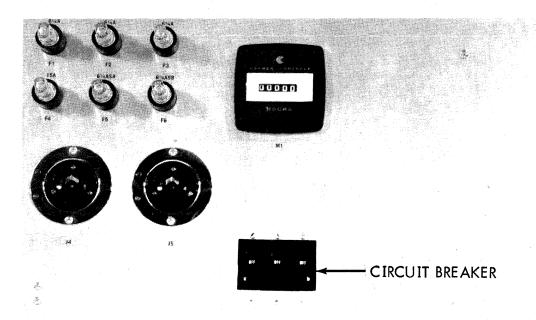


Figure 2–3. A–C Control Panel

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The interface panel contains the EQUIPMENT SELECTOR rotary switch (figure 2-4) for selecting a specific external equipment address 0 through 7 for the Display Controller. The switch setting also determines which interrupt line to the computer is used. Four receptacles are provided for connecting the Display Controller to the computer; only two are used at one time. The other two should be terminated if not in use.

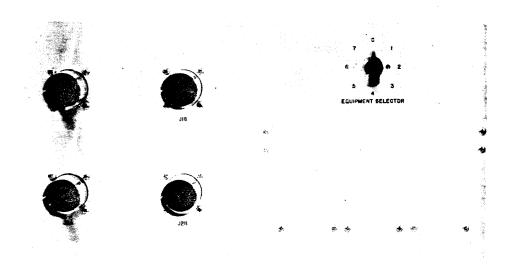


Figure 2-4. Display Controller Interface Panel

Figure 2-5 shows the Data Set interface panel. This panel provides the power and data outlets for two pollers. J1 and J2 are the data cable receptables while J3 and J4 provide 120-volt ac, 60 Hz power to the Data Set.

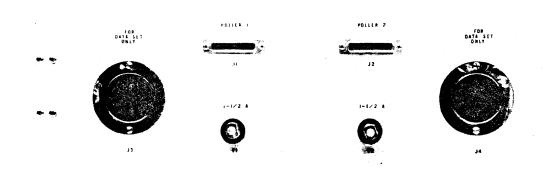


Figure 2-5. Data Set Interface Panel

DISPLAY STATION.

Rotating the ON/OFF/INTENSITY control, located on the right side of the Display Station, toward the rear of the cabinet turns the Display Station on; further rotation increases the intensity of the displayed symbols. The ON/OFF/INTENSITY control being off does not prevent communication on the interface between the computer and the delay-line memory and does not disable keys on the keyboard, except the SHIFT key. Figure 2-6 shows the Display Station and figure 2-7 shows the Display Station keyboard.

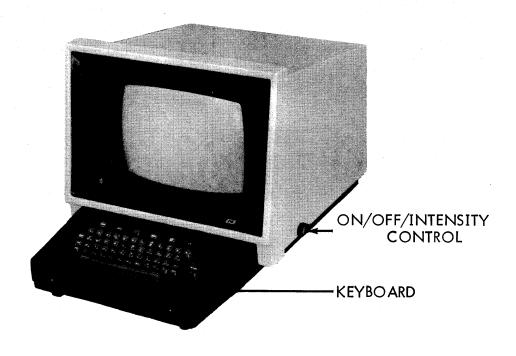


Figure 2-6. Display Station

Four rows of keys on the Display Station keyboard enter symbols into the delay line for display on the crt. Depression of a key enters the code for the symbol indicated on the key into memory at the position of the entry marker, generates the symbol on the crt, and advances the entry marker. The keyboard is inoperative during the following intervals:

- (a) SEND key is depressed until the end of a read message from or a write message to that station.
- (b) PRINT key depressed until printout is complete. The CLEAR key is not locked out during printout.



Figure 2-7. Display Station Keyboard

- (c) The station is connected and the Channel Busy signal is a logical 1.
- (d) Reset function or reset clear function is being performed by the Display Station.

The following list explains the operation of the control keys.

Clear.

Depress the CLEAR key to clear all data from the delay line and from the crt. The entry marker moves to the upper left corner of the screen. This operation prevents sending or receiving data from the time the key is depressed until 16.8 microseconds to 20 milliseconds after the key is released. (The time variation is due to latency characteristics of the delay line).

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Operation

Reset.

Depress the RESET key to move the entry marker to the upper left corner without affecting data. This operation prevents sending or receiving data from the time the key is depressed until 16.8 microseconds to 20 milliseconds after the key is released.

Shift.

Continued depression of either SHIFT key enables entry of the upper symbol on the two-symbol keys. Operation of the single-symbol keys is not affected by the SHIFT keys; all alphabetic symbols are displayed in uppercase form. The SHIFT keys are nonlocking.

Space.

Operating the SPACE key stores a space code in the delay line at the position of the entry marker and advances the entry marker. Data is not affected.

Skip.

Depress the SKIP key to move the entry marker one space forward. Data is unchanged.

Repeat.

Operating the REPT key in conjunction with another key enables a repeated action of that key's character/function. CLEAR, PRINT, RESET, SEND, and SHIFT keys are not affected by the REPT key.

Backspace.

The BKSP key moves the entry marker one space back without changing data. Backspace is accomplished in 10 milliseconds minimum to 90 milliseconds maximum, during which time no data can be transferred on the data channel.

Line Skip.

Depress the LINE SKIP key to advance the entry marker to the beginning of the next line. Line skip is accomplished in 151.2 microseconds minimum to 1 millisecond maximum, during which time no data is transferred between a connected Display Station and the computer.

Return.

Operation of the RETURN key inserts a carriage return code at the entry marker position and moves the entry marker to the first symbol position on the next line. The carriage return is displayed as a superscript dash (). The return takes from 151.2 microseconds (if the entry marker is at the end of a line) to 1 millisecond (if the entry marker is at the beginning of a line), during which time no data can be transferred between the Display Station and the computer.

Send.

The SEND key stores an end of message symbol (elevated $^{\Delta}$) at the entry marker position and moves the entry marker to the upper left corner. Data transfer is prevented during the time (16.8 microseconds minimum to 20 milliseconds maximum) the entry marker is moving.

Print.

Operation of the PRINT key stores an end of print code (') at the entry marker position, moves the entry marker to the upper left corner, and initiates printout of data from the upper left corner to the end of print code on an associated Printer Station. The keyboard, except for the CLEAR key, is disabled during printout. During printout, the Display Station is not ready to the computer.

PRINTER STATION.

Figure 2-8 shows the Printer Station typewriter controls. Note the location of the ON/OFF switch to the right of the keyboard. A multipaper adjustment (top left) provides even printing for carbon copies. Remaining controls are common

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to an electric typewriter and include the following: platen knobs for manually advancing the paper, a line space lever for single or double spacing, a paper release lever, left and right visible margin stops, an impression selector lever which adjusts the striking force of the typing element, a tab set and clear control, tab key, index key, shift keys, margin release, space bar, etc.

Refer to the IBM Selectric Manual supplied with the equipment for more detailed information about the typewriter.

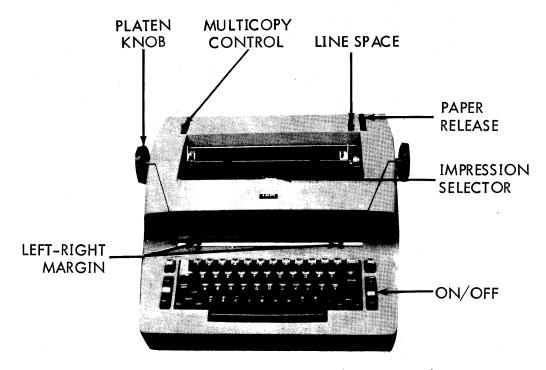


Figure 2–8. Printer Station Typewriter Controls

OPERATING PROCEDURES.

The remainder of this section describes normal operating procedures for the display equipment. Included are turn on/turn off procedures followed by a typical operation sequence.

TURN ON/TURN OFF.

Turn on/turn off procedures are listed in table 2-2. For precautionary measures, it is recommended the steps be followed in the order listed.

TABLE 2-2. TURN ON/TURN OFF PROCEDURES

	TABLE 2 2. TORIA OTA TORIA OTT TROCEDORES			
STEP	LOCATION	OPERATION		
	TURN ON			
1	Display Controller	Place the POWER ON/OFF switch in the ON position. Move RUN/MASTER CLEAR switch to MASTER CLEAR position, then to RUN position.		
2	Display Stations	Rotate the ON/OFF/INTENSITY control to the ON position. Depress the CLEAR key. After a 30-second warmup period, rotate ON/OFF/INTENSITY control until the entry marker is visible.		
3	Printer Stations	Depress the ON/OFF rocker switch to the ON position.		
	! -	TURN OFF		
1	Printer Stations	Depress the ON/OFF rocker switch to the OFF position.		
2	Display Stations	Rotate the ON/OFF/INTENSITY control to the OFF position.		
3	Display Controller	Place the POWER ON/OFF switch in the OFF position.		

TYPICAL OPERATION SEQUENCE.

Figure 2-9 is a flow diagram depicting a typical operation sequence. Depress the CLEAR key on the Display Station keyboard to clear the display screen. The operator then enters data via data entry keys. When data is properly composed, it may be sent to the computer by actuation of the SEND key, or to a Printer Station, which shares memory with the Display Station, by depressing the PRINT key.

The computer may respond to properly transmitted data by sending the requested data or a message acknowledging receipt of the transmitted data. The operator may then print the reply data, or edit it (eg, filling in information on a blank form, or updating stored data), and transmit the edited data back to the computer.

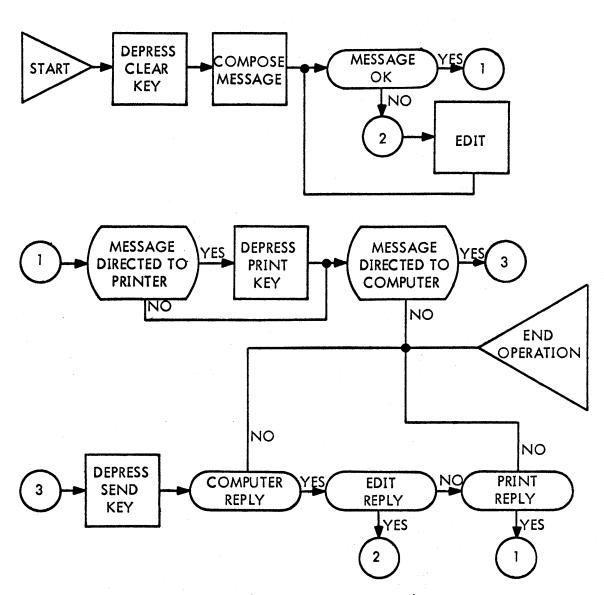


Figure 2-9. Typical Operation Sequence Flow Diagram

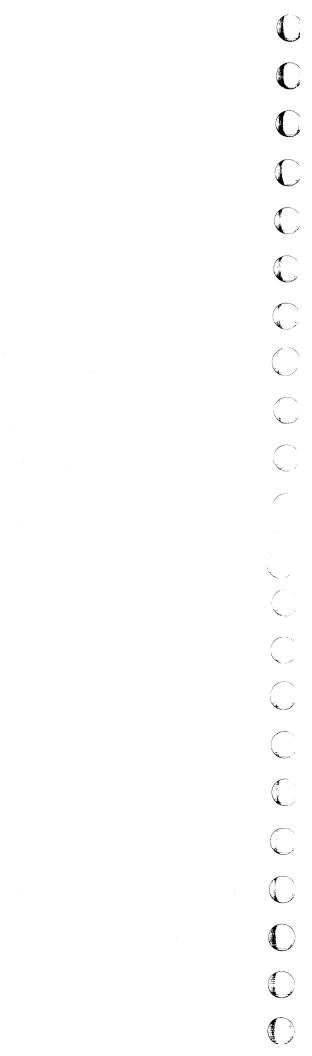
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SECTION III

PROGRAMMING

This section describes programming aspects of the display equipment. It provides a complete description of signals, function and status codes, interrupts, symbol data, word formats, various read/write operations, and programming aids for both interface and poller assemblies.

INTERFACE SIGNAL LINES.

The Display Controller operates from the standard (12 bit) 3000 Series standard communications channels. Figure 3-1 shows the interconnecting data and control lines between the computer communications channel and the Display Controller. Following is a description of each line or group of lines.

DATA LINES (12).

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There are 12 bidirectional data lines. During a read operation (input to the computer), these data lines carry data, 12 bits at a time, from the Display Controller to the computer. During a write operation (output from the computer), the data lines carry data from the computer to the Display Controller. The data lines also are used to transmit the 12-bit connect and function codes associated with Connect and Function signals, respectively.

PARITY LINE.

A parity bit accompanies each 12 bits of data, connect code, and function code transmitted between the computer and the Display Controller. Odd parity is used, ie, the total number of 1's transmitted is always an odd number.

CONNECT LINE.

A Connect signal is sent to the Display Controller when a 12-bit connect code is available on the data lines. The Display Controller connects only if the following conditions are met:

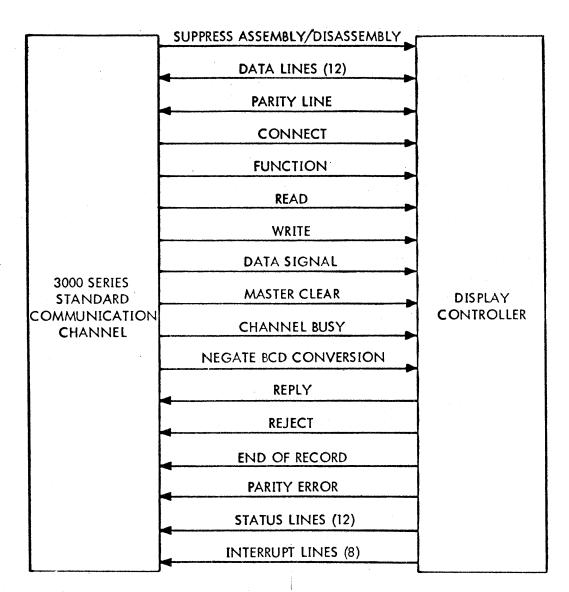


Figure 3-1. Computer/Display Controller Interface Lines

- (a) The most significant 3 bits of the connect code must match the number setting of the EQUIPMENT SELECTOR switch.
- (b) Display Controller power is on.
- (c) The RUN/MASTER CLEAR switch is in the RUN position.
- (d) Parity is correct.

No response is returned when a parity error exists on the connect code; however, the red PARITY error indicator on the Display Controller maintenance panel (figure 2-1) lights on all Display Controllers and external equipment controllers associated with that communications channel. After a delay of 100 microseconds, the communications channel generates its own internal Reject signal.

Once a Display Controller is connected to the computer, it remains connected until the communications channel initiates a disconnect. To perform a disconnect, send any connect code with the upper 3 bits not matching the Display Controller EQUIPMENT SELECTOR switch setting, a Master Clear signal, or a release function code.

FUNCTION LINE.

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A Function signal is sent to the Display Controller when a 12-bit function code is available on the data lines (function codes are listed under interface control codes). If the Display Controller is connected to the computer and is capable of executing the specified function at the time it receives the Function signal, it initiates the function and returns a Reply signal. If the Display Controller cannot perform the function, it returns a Reject signal. The Function signal and 12-bit function code drop when a Reply or Reject signal is returned. If a Reply or Reject signal is not returned within 100 microseconds, the computer generates its own internal reject.

The specified function is not performed if a parity error exists on the function code; however, a Parity Error signal is returned by the Display Controller and the red PARITY error indicator on the Display Controller maintenance panel (figure 2-1) lights.

Once a function code is accepted by the Display Controller, all other function codes are locked out until the first one is acted upon. The Display Controller does not hold or stack up the function codes; a Reply or Reject signal is returned within 5 microseconds. If a second function code is received which specifies the same function as the previous function code, the second function code is rejected unless the function can be performed immediately a second time.

READ LINE.

A Read signal transmitted to the Display Controller directs the Display Controller to begin reading data from a specified Display Station memory.

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WRITE LINE.

A Write signal transmitted to the Display Controller directs the Display Controller to begin writing data into a specified Display Station memory.

DATA SIGNAL LINE.

A Data signal is sent from the computer to the Display Controller for each 12-bit data word during read and write operations. The Data signal drops when a Reply (or End of Record) signal is transmitted by the Display Controller.

During a read operation, the Data signal indicates that the computer is ready to accept a 12-bit data word from the Display Controller. During a write operation, the Data signal indicates that the computer placed a 12-bit data word on the data lines.

MASTER CLEAR LINE.

A Master Clear signal sent from the computer returns the Display Controller to its initial clear condition and starts the polling operation.

CHANNEL BUSY LINE.

A Channel Busy signal is sent to the Display Controller when the computer communications channel is active during a read or write operation.

NEGATE BCD CONVERSION LINE.

When the Negate BCD Conversion signal is a logical 1, external BCD codes are used; when the Negate BCD Conversion signal is a logical 0, internal BCD codes are used. Refer to Symbol Data in this section.

REPLY LINE.

The Display Controller transmits a Reply signal in response to the following:

- (a) A connect code having no parity error and containing a matching Display Controller EQUIPMENT SELECTOR switch equipment select code and proper select code.
- (b) A function code received with no parity error if the Display Controller is capable of executing the specified function at the time it receives the Function signal.
- (c) During a write operation after the Display Controller has read a data word.
- (d) During a read operation when the Display Controller has a word on the data lines (see End of Record signal for exception).

The Reply signal drops when the Connect, Function, or Data signal drops.

REJECT LINE.

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The Display Controller transmits a Reject signal in response to the following:

- (a) A connect code (with no parity error) specifying a nonexistent or busy station.
- (b) A function code (with no parity error) specifying an illegal function.
- (c) A function code (with no parity error) which cannot be performed within 5 microseconds after receipt of the Function signal (refer to programming aids for such conditions).
- (d) An alert function to a poller that had its alert request status cleared, or an alert function to any station other than a poller.

SUPPRESS ASSEMBLY/DISASSEMBLY LINE.

During a read operation, the Suppress Assembly/Disassembly signal forces the Display Controller to assemble logical 0's in bits 6 through 11 of each 12-bit data byte. In a write operation, bits 6 through 11 are not used when the Suppress Assembly/Disassembly line is enabled. The signal has no effect on the address word during a read operation initiated by an interrupt.

END OF RECORD LINE.

The Display Controller transmits an End of Record signal (instead of a Reply signal) in response to the next Data signal following transmission of EOM signal. The End of Record signal drops when the Data signal drops. If the Read signal drops before the read operation completes, the End of Record signal is not transmitted because the remaining data is not transmitted.

PARITY ERROR LINE.

The Display Controller transmits a Parity Error signal when a parity error occurs on a function code or write operation. No Parity Error signal is generated for a parity error occurring on a connect code or read operation. During a write operation, a parity error on one word of a 12-bit byte results in display of both words as parity error symbols when the Suppress signal equals 0.

STATUS LINES (12).

The Display Controller places information on the 12 available status lines following a connect operation to indicate its operating conditions to the computer. Display equipment status remains enabled to the computer until a disconnect is sent from the computer. The computer may sample the status lines at any time. Status bits are listed under interface control codes.

INTERRUPT LINES (8).

Each Display Controller and external equipment controller attached to a given computer communications channel is assigned to one of eight separate interrupt lines selected by the EQUIPMENT SELECTOR switch. The interrupt line indicates to the computer that a predetermined condition has been reached. The interrupting condition can be determined by program sampling the status lines following transmission of an Interrupt signal if connected.

INTERFACE CONTROL CODES.

Interface control codes include connect, function, and status codes. The connect code is used in addressing the display equipment. Function codes, with

the exception of reset, alert, and release, set up and remove interrupt conditions in the Display Controller. Status codes indicate what conditions exist at the Display Controller. Following is a description of the connect code, display equipment function codes, and status line assignments.

CONNECT CODE.

The connect code is 12 bits long and is transmitted to the Display Controller on the 12 data lines along with a Connect signal on the connect line. The Display Controller interprets the connect code (figure 3-2) as follows:

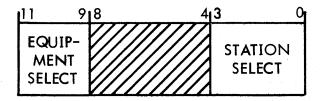


Figure 3-2. Connect Code

Bits 9 through 11 designate the number setting of the Display Controller EQUIPMENT SELECTOR switch. The station select portion of the connect code allows selection of a Display Station or poller or selection of a Display Station or poller that caused an interrupt. Bits 4 through 8 are not interpreted.

FUNCTION CODES.

Function codes are 12 bits long and are transmitted to the Display Controller on the data lines along with a Function signal on the function line. Table 3-1 lists and describes Display Controller function codes.

STATUS CODES.

Twelve status lines are available for indicating display equipment operating conditions to the computer. The computer may sample these lines at any time.

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TABLE 3-1. DISPLAY CONTROLLER FUNCTION CODES

	TABLE 3-1. DISTERT C	ONTROLLER FUNCTION CODES
OCTAL CODE	FUNCTION	DESCRIPTION
0000	Release	Disconnects the Display Controller from the computer and clears all interrupt selections and parity error indications. Also master clears a poller if the poller is connected.
0010	Reset Entry Marker	Positions the entry marker on selected Display Station or poller to upper left corner to prepare for a read or write. The Display Station or poller indicates busy status for 3.2 microseconds to 20 milliseconds after receipt of the function. Generally precedes a write or computer-initiated read.
0011	Reset-Clear	Similar to a reset entry marker function except data is cleared from the delay line. When addressed to a poller, the function does not clear the delay line but clears existing send requests. The Display Station or poller indicates busy status for 20 to 40 milliseconds upon receipt. Generally precedes a write to local station.
0020	Select Interrupt for Ready and Not Busy (Note 1)	Allows generation of an interrupt when printer operation completes. Reselection removes an interrupt resulting from a previous selection.
0021	Clear Interrupt Enable for Ready and Not Busy (Note 1)	Removes interrupt and selection resulting from code 0020.
0022	Select Interrupt on End of Operation (Note 1)	Allows generation of an interrupt when the read or write operations or a reset or a reset clear operation completes. Reselection removes interrupt resulting from a previous operation.

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TABLE 3-1. DISPLAY CONTROLLER FUNCTION CODES (CONT)

OCTAL CODE	FUNCTION	DESCRIPTION
0023	Clear Interrupt on End of Operation (Note 1)	Removes interrupt and selection result- ing from code 0022.
0024	Select Alert Interrupt	Allows generation of an interrupt upon completion of an alert message by a poller. Reselection removes an interrupt resulting from a previous operation.
0025	Clear Alert Interrupt	Clears interrupt and selection due to code 0024.
0026	Select Station Interrupt (Note 1)	Allows generation of an interrupt if a SEND key on a Display Station is depressed, if a poller receives a read message in response to a poll message or if an error is indicated. Reselection removes an interrupt resulting from a previous selection if a read or write operation is performed on the interrupting station prior to reselection. Stacking of station interrupts is possible and, if more than one station has had its SEND key depressed, another interrupt occurs immediately after reselection.
0027	Clear Station Interrupt (Note 1)	Removes interrupt and selection result- ing from code 0026.
(Note 2)	Alert Poller	Instructs connected poller to send an alert message to the addressed remote site and station. Alert occurs in the polling sequence. If the alert is sent to a local station, it is rejected.
1	Note 1 — affect o	Il stations simultaneously.

Note 2 — 1XXXXXXXX0011 binary.

Table 3-2 identifies status conditions, lines, and octal codes characteristic of the Display Controller. The computer may sample any single status line or group of lines.

All conditions listed in table 3-2 except send request and print request, are general status conditions; ie, the computer connects only to the Display Controller and any existing station before sampling status. Lines 0, 2, 3, 4, 5, and 10 are on a per station basis, ie, a specific station must be referred to before sampling status. Lines not listed in table 3-2 are not used.

TABLE 3-2. DISPLAY CONTROLLER STATUS CONDITIONS

LINE	OCTAL CODE	CONDITION	DESCRIPTION
0	XXX1	Ready	The Display Controller is ready when power is on and the RUN/MASTER CLEAR switch is in the RUN position. A particular station may become not ready if an operator depresses the PRINT key and the printer begins printout.
1	XXX2	Busy	The Display Controller is busy when the Channel Busy and the Read signal or Write signal is active, or when the reset or reset-clear function is executed. The Display Station keys are inoperative during a read or write operation.
2	XXX4	Send Request	Indicates on a per station basis that an operator depressed the SEND key or that a connected poller has a read message or a message in error.
3	XXIX	Print Request	Indicates on a per station basis that a print operation is requested by the station or it is performing a print operation.
4	XX2X	Poll Message Error	Indicates that the connected poller was unable to receive an expected response to a poll message in three attempts.

LINE	OCTAL CODE	CONDITION	DESCRIPTION
5	XX4X	Alert Request	A connected poller is ready to process an alert function from the computer. Any previous alert function has been processed.
6	XIXX	Station Interrupt	Indicates that a station interrupt was caused by depressing one or more SEND keys, or that a poller detected a message in error or received a read message.
7	X2XX	Ready and Not Busy Interrupt	Indicates that a ready and not busy interrupt was generated when print-out completed and that the ready and not busy interrupt was selected.
8	X4XX	End of Operation Interrupt	Indicates that an interrupt was generated by the end of a read/write operation, reset, or reset-clear function. A new function, or read or write operation may be initiated following the end of operation interrupt.
9	1XXX	Alert Interrupt	Interrupt generated by completion of an Alert message to a remote site.
10	2XXX	Poller Error	Error condition after three attempted write, clear-write, write-reset, or alert messages to a remote site from the connected poller.

INTERRUPTS.

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The interrupt permits the display equipment to indicate to the computer certain preprogrammed conditions. The computer can selectively activate or deactivate these interrupt conditions.

Four conditions generate an interrupt and four function codes enable these interrupts to the computer for the Display Controller. Table 3-3 lists the interrupt conditions, enabling functions, and disabling functions. Refer to the specific enabling function code (table 3-2) for a complete description of the interrupt condition.

TABLE 3-3. DISPLAY CONTROLLER INTERRUPTS

TA ITE DOLLOT	FUNCTION CODE			
INTERRUPT	ENABLE	DISABLE		
Ready and Not Busy	0020	0021		
End of Operation	0022	0023		
Alert	0024	0025		
Station	0026	0027		

The computer must first connect to a specific Display Station before issuing any interrupt enable function codes. Normally, status is checked immediately following the connect. If the computer desires to perform a reset operation (function code 0010), or a read or write operation, and wants to be informed when the operation is completed, it transmits function code 0022 (interrupt on end of operation) prior to the operation.

An end of printout operation can interrupt the computer if the ready and not busy interrupt is enabled. After connecting to a specific Display Station and finding the station busy executing a printout, the computer has the option to discontinue the printout or select the interrupt on ready and not busy condition (function code 0020). Even though the function code is directed to a specific Display Station, it enables a station interrupt from any Display Station satisfying the ready and not busy condition.

If the computer wants to receive the data from a local Display Station, function code 0026 (station interrupt enable) is transmitted. An interrupt transmits when the SEND key on this station, or any other Display Station, is depressed.

Upon receiving an interrupt from the display equipment, the computer normally connects to the Display Controller and samples status to determine what caused the interrupt. It can immediately perform a read operation following a connect word having a select code 0000 if the interrupt is a station interrupt. A write operation or other interrupt requires connecting to a specific station before beginning the operation. After servicing an interrupt, the interrupt line may be cleared by reselecting or deselecting the same interrupt except station interrupt.

SYMBOL DATA.

The display equipment symbol repertoire includes the alphabet in uppercase, arabic numerals (0 through 9), punctuation marks, and special symbols.

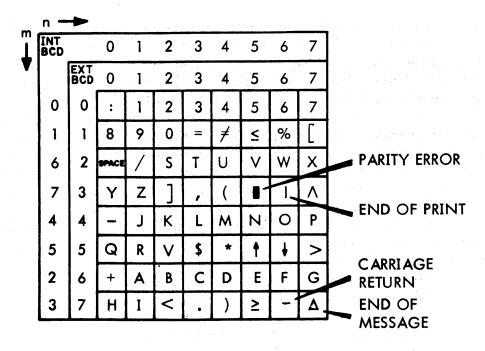
Table 3-4 presents the Display Controller symbol repertoire in alphabetic and numeric order. Figure 3-3 shows two quick reference charts for locating a

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TABLE 3-4. SYMBOL REPERTOIRE

	BCD			ВС	D	CVAADOL	BCD	
SYMBOL	EXT	INT	SYMBOL	EXT	INT	SYMBOL	EXT	INT
Α	61	21	x	27	67	Comma ,	33	73
В	62	22	Y	30	<i>7</i> 0	Left paren (34	74
С	63	23	Z	31	71	Parity error	35	75
D	64	24	Colon :	00	12	End of	36	76
E	65	25	1	01	01	print (Note)	077	-7-7
F	66	26	2	02	02	Logical OR ^	37	77
G	67	27	3	03	03	Hyphen -	40	40
Н	70	30	4	04	04	Logical AND	52	52
I	71	31	5	05	05	Dollar sign \$	53	53
j.	41	41	6	06	06	Asterisk *	54	54
K	42	42	7	07	07	Arrow up	55	55
L	43	43	8	10	10	Arrow down	56	56
M	44	44	9	11	11	Greater than >	57	57
N	45	45	ø	12	00	Plus +	60	20
0	46	46	Equal =	13	13	Less than <	72	32
Р	47	47	Not equal ≠	14	14	Period .	73	33
Q	50	50	Less than or ≤	15	15	Right paren)	74	34
R	51	51	equal to Percent %	16	16	Greater than	75	35
S	22	62	_	. 1	1	or equal to ≥		
T	23	63	Left bracket [1	60	Carriage	76	36
U	24	64	Space	20		return (Note)	77	37
V	25	65	Right diagonal /	21	61	End of Δ message	′′	3/
W	26	66	Right bracket	32	12			

Note — displayed as superscript, does not print.



NOTE:

00 internal BCD equals 12 external BCD 00 external BCD equals 12 internal BCD

Figure 3-3. Symbol Code Quick Reference Chart

symbol when given the 6-bit octal or BCD code. A two-digit code of the form m/n uniquely specifies each code, eg, external BCD code 65 represents the letter E.

Standard display format is 20 lines of 50 symbols per line with an optional display format of 13 lines of 80 symbols available. The Display Station INTENSITY/ON/OFF switch adjusts symbol intensity. Symbol size is adjustable internally and is normally set to generate symbols 1/8-inch wide by 1/4-inch high.

WORD FORMATS.

The display word format is 6 bits. Each 6-bit word specifies a symbol code or control code as listed in the symbol repertoire table.

Besides the display word format, there are five 12-bit interface word formats. The connect, function, data, and station word are transmitted on the data lines and are identified by a signal transmitted on a corresponding signal line. The status word is enabled to the computer on the status lines whenever the Display Controller is connected to the computer.

Table 3-5 lists all word formats and identifies the distinguishing signal where applicable.

TABLE 3-5. WORD FORMATS

WORD	FORMAT	SIGNAL
Display	5 CODE	
Connect	EQUIP- MENT SELECT 98 43 O STATION SELECT	Connect
Function	FUNCTION CODE	Function
Data	SYMBOL 1 SYMBOL	Data
Status	STATUS CODE	
Station	REMOTE REMOTE REQUESTING SITE STATION STATION CODE CODE CODE	Data
Alert Function	REMOTE REMOTE 0011	Function

The connect word contains information which directs the Display Controller to connect the computer data channel to the designated Display Station or poller. Bits 9 through 11, the equipment select code, designates the equipment number which may be chosen on the EQUIPMENT SELECTOR switch. Bits 0 through 3 (the station select code) are used to select the specific local Display Station or poller with which the computer is to communicate. A station select code of 0001 through 1100 binary designates the corresponding numbered Display Station or poller. A station select code of 0000 binary indicates that the computer requests a check of status conditions, or requests to communicate with the lowest numbered Display Station causing an interrupt. If no interrupt is present, connection is prevented.

Figure 3-4 shows the sequence of events upon receipt of a Connect signal. If the Display Controller is in a ready state, parity is checked upon receipt of the Connect signal. A parity error at this time illuminates the PARITY indicator and the display equipment disconnects in approximately 1 microsecond. Assuming parity is correct, the EQUIPMENT SELECTOR switch setting is compared to the equipment select code. If the two do not compare, a disconnect is performed in about 1 microsecond. An exact comparison allows the status lines to be enabled. After comparing the equipment select code, the Display Controller examines the station select code to see if it is addressing an existing Display Station or poller. If the device is non-existent or busy, a Reject signal is transmitted to the computer no sooner than 2 microseconds after the condition is detected. Assuming the Display Station or poller exists and is not busy, the Display Controller responds with a Reply signal in about 2 microseconds.

If the station select code contains all 0's and an interrupt condition is not pending, a Reject signal is sent to the computer. An interrupt condition at this time draws a Reply signal response from the Display Controller and the interrupting Display Station or poller is connected. The computer then reads at least one word (the station word) and normally continues the read operation until all of that station's data is read. If the interrupt condition is nonexistent, a connect is made to the Display Controller for reading Display Controller status only. No read or write operation is performed.

Once connected, the Display Controller is ready to perform any function desired by the computer in addition to a read or write operation. Figure 3-5 shows the sequence of events upon receipt of a Function signal. If the Display Controller is not connected, it takes no action in response to a Function signal.

An assembly/disassembly register in the Display Controller handles packing and unpacking chores for read and write operations respectively. The most significant 6 bits of the data word are always filled or emptied first. If the computer enables the Suppress Assembly/Disassembly line, the most significant 6 bits would

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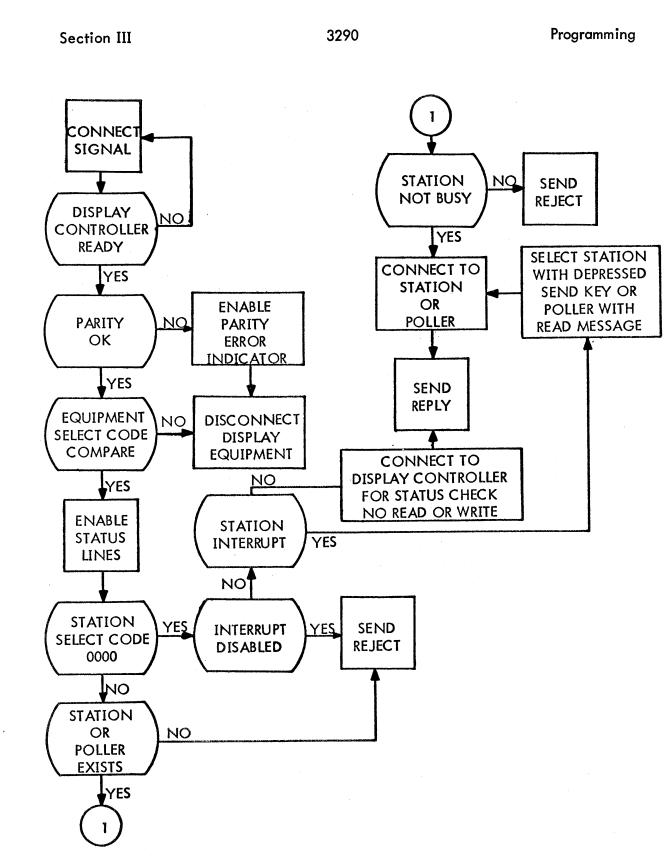


Figure 3-4. Connect Sequence

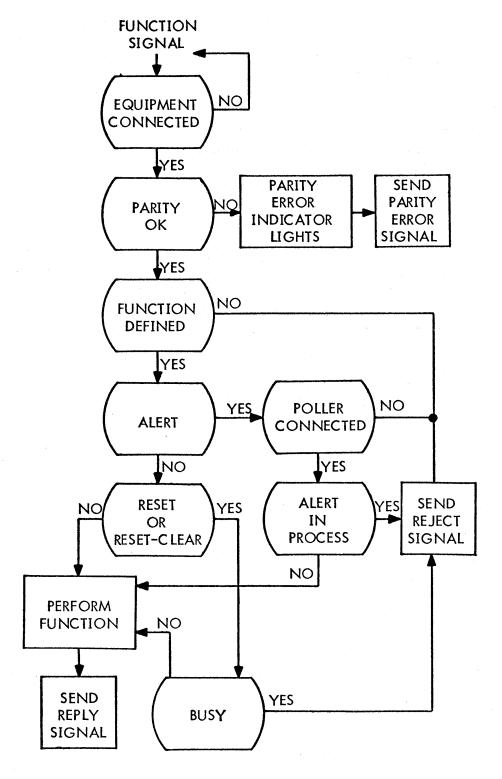


Figure 3-5. Function Sequence

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neither be filled or emptied for the duration of the signal. The least significant 6 bits are unaffected; therefore, data transmission takes place in the form of one 6-bit word at a time.

READ/WRITE OPERATIONS.

Read or write operations to or from a local Display Station may be performed any time at the discretion of the computer, after checking status. The computer-initiated action takes priority over the operator. If a read or write operation is initiated during a period when an operator is composing a message from the keyboard, the operator's keyboard is locked out and computer operation takes over. A read or write operation to a Display Station performing a printout results in termination of the printout and the read or write operation is performed at the specified Display Station.

The Display Controller allows the computer to enable an interrupt on an end of printout condition. Following connection to a specific Display Station and sampling status, print request status (line 3) is enabled if the Display Station requests a print operation or if it is presently performing a printout. Not ready status indicates the Display Station is actually performing a printout. Using function code 0020 octal, the computer may enable the select interrupt on ready and not busy condition. Upon completing printout, an interrupt is sent to the computer and status line 7 (ready and not busy interrupt) is made active. The 0020 function code enables an interrupt to generate when any Display Station completes printout.

Computer read and write operations do not take priority in the poller. The poller scans the remote stations to determine if a SEND key is depressed. If this condition exists, the selected station transmits a read message to the poller. After storing the message in memory, the poller generates a send request and the computer responds with a read operation. In response to the read message, the computer must send a write message to the selected poller. The poller then relays this message to the remote station.

The alert function turns on the ALERT light and audible alarm at the remote station; the SEND key must be depressed to turn them off. The subsequent read message enables the computer to perform a write operation.

Read operations may be initiated from the local or remote Display Stations by an operator depressing the SEND key or from the computer by programmed instructions (local Display Station only). A write operation is initiated only from the computer. Following is a description of read and write operations.

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READ OPERATION INITIATED BY A REQUESTING STATION.

A requesting station is a local Display Station at which a SEND key was depressed, or a poller which received a read message from a remote station. At a requesting station an end of message symbol is inserted at the entry marker position, the entry marker is moved to the upper left corner, and a station interrupt is initiated if the station interrupt is enabled by the computer. The computer responds to the interrupt with a connect word containing a station select code of 00 octal. The Display Controller then connects to the requesting station in scanning sequence and activates the status lines. The computer must perform a read operation to clear the send request. If a read operation is not performed, the station interrupt is sent again upon receipt of the station interrupt enable.

The station word (shown in table 3-5), containing the number of the scanner selected requesting station, is sent in response to the first Data signal during a station-interrupt initiated read operation. If the selected requesting station is a poller, the remote site and station are indicated in bits 4 through 10. Successive words after the station word contain data stored in the delay line starting at the entry marker position.

When the end of message code is detected, it is sent to the computer in a data word. In response to the next Data signal following an end of message code, the End of Record signal accompanied by an all-zero data word is sent instead of the Reply signal. The Read signal terminates the read operation and becomes disabled for more than 200 nanoseconds. Data may therefore be read beyond the end of message code if the Read signal remains enabled. Figure 3-6 shows simplified read operation timing.

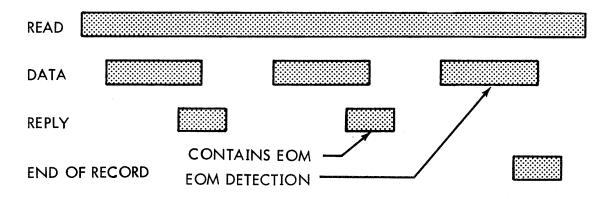


Figure 3-6. Simplified Read Timing

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If successive read operations are performed without resetting the entry marker (such as repetitive one-word reads) one symbol is lost each time the Read signal is dropped.

READ OPERATION INITIATED BY THE COMPUTER.

The computer may initiate a read operation at any time the connected local Display Station or poller is not busy. Discretion is required in the use of this operation since it prevents entry of data by a Display Station operator. After connecting, the entry marker may be moved to the upper left corner by the reset function or may be left at its current position. In response to the Read and Data signals, data words are sent along with the Reply signal. A read operation performed on a connect to a specific station does not send the station word.

WRITE OPERATION TO A LOCAL DISPLAY STATION.

Data may be written into a connected station at any time the station is not busy. After connecting and checking status, the computer sends data words to be written on the crt starting at the position of the entry marker. A reset or reset-clear function may move the entry marker to the upper left corner before writing data. Sequential symbols in data words are written from left to right and from top to bottom on the crt. After the last symbol is written in the lower right corner, the entry marker moves to the upper left corner and data writing may continue, with the later data replacing data written earlier. Figure 3-7 shows simplified write operation timing.

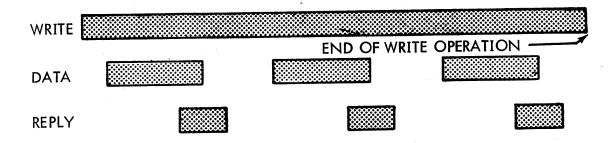


Figure 3-7. Simplified Write Timing

WRITE OPERATION TO A POLLER.

Data is always transferred to a poller after a read operation from the poller. After connecting to the poller and checking status, the computer sends data words

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to be written into the poller memory starting at the position of the entry marker. The entry marker is always at start-of-memory after any computer read operation.

A reset function immediately preceding a write to the poller results in a write-reset message from the poller to the remote station; a reset-clear function results in a clear-write message. No function results in write message. Sequential symbols in data words are written into the poller memory. The poller is informed that it is to send the message when the Write signal drops. The write, write-reset, or clear-write message is sent to the remote station which had just previously sent a read message.

PROGRAMMING AIDS.

Following are several points concerning display equipment timing:

- (a) The Display Controller is busy for 33 microseconds after the last Reply signal is sent at the end of a write operation.
- (b) The Display Controller is busy from 3.2 microseconds to 20 milliseconds after receipt of a reset function.
- (c) If a read or write operation follows a reset function which transmits an interrupt upon completion, 20-millisecond delay (after the end of operation interrupt is sent) occurs before the first data word is stored or read from memory.
- (d) One symbol time is 16.8 microseconds. Each data word contains two symbols and requires 33.6 microseconds. The delay-line memory cycle time is 20 milliseconds. During a read or write operation, successive data words must follow within 33.6 microseconds (time required to read or write two symbols) or a 20-millisecond delay occurs between bytes due to delay line latency characteristics.

PROGRAMMING RESTRICTIONS.

- (a) It is necessary to read at least two 12-bit words to clear the send ff when a connect is issued after an interrupt.
- (b) There should not be any unsolicited read or write operations (poller only).
- (c) Sending an end of print message to a Display Station initiates operation of its associated Printer Station(s).

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POLLER TRANSLATION.

The poller converts all codes and signals to a format which is compatible with Data Set operation. Signals transmitted between the poller and the Data Set meet or exceed the minimum of EIA Standard RS-232. A negative voltage of greater than -6 volts represents a logical 1; a positive voltage greater than +6 volts represents a logical 0. Half duplex, 2- or 4-wire operation, DATA-PHONE Data Set 201A or 201B service is required. Private communications lines are necessary and no provision is made for automatic ringing or answering.

A single-phase, 120-volt, 60-Hz, three-wire outlet from the Display Controller is supplied for the Data Set, so the same ground bus is used for both. This measure is necessary to prevent impulse noise potentials which might otherwise develop and cause data errors.

The poller sends and receives data in an 8-bit code which is transmitted serially over Send Data and Receive Data lines. These bits are synchronized with the Serial Clock Receive and Serial Clock Transmit signals. Data Set 201A operates at 2000 baud, Data Set 201B at 2400 baud.

INTERFACE SIGNALS.

Figure 3-8 shows interface signals between the Data Set and the poller. The arrows indicate signal origin. Following paragraphs provide an elaboration on the signals shown in figure 3-8.

Send Data.

O

The Send Data signal originates in the poller and contains serial data. Positive polarity represents a logical 0 and negative polarity represents a logical 1. Data bits are provided to the Data Set at the time of positive transition of the Serial Clock Transmit signal.

Request to Send.

The poller makes the Request to Send signal positive when a transmit operation is desired. Placing a negative potential on the line returns the Data Set to a receive condition.

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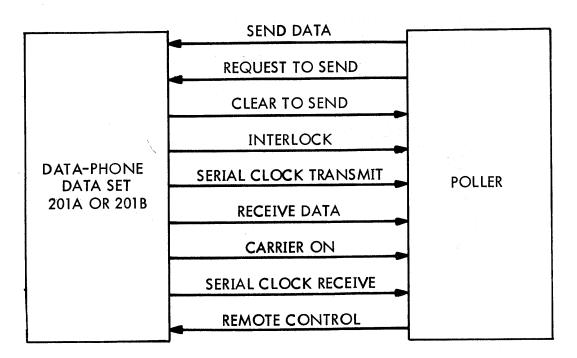


Figure 3-8. Poller Interface Signals

Clear to Send.

The Data Set makes the Clear to Send signal positive in response to a Request to Send signal from the poller. The amount of time elapsed between the leading edge of the Request to Send and the leading edge of Clear to Send is determined by the Data Set strapping options. The Data Set makes the Clear to Send signal negative when the Request to Send signal drops.

Interlock.

A+6 volts on the Interlock Line indicates that the Data Set is ready to send or receive data. A 0-volt signal indicates that the Data Set is not in an operating condition.

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Serial Clock Transmit.

The Serial Clock Transmit signal is a symmetrical square wave of +6 volts to -6 volts amplitude originating in the Data Set which is used to synchronize the acceptance of data by the Data Set. Data is placed on the Send Data line at the time of the positive transition of the Serial Clock Transmit signal and is sampled by the Data Set at the time of negative transition.

Receive Data.

The Receive Data signal contains serial binary data which is synchronized with the Serial Clock Receive signal. Positive polarity is defined as a logical 0 and negative polarity as a logical 1.

Carrier On.

O

A positive potential at the Carrier On terminal indicates that the Data Set is receiving the carrier. A negative potential indicates that no carrier is being received. The Carrier On signal changes from negative to positive within 9 milliseconds after carrier appears at the receiver terminal.

Remote Control.

A positive potential indicates that the poller is ready to communicate with the Data Set.

Serial Clock Receive.

The Serial Clock Receive signal is a symmetrical square wave of +6 volts to -6 volts amplitude. The square wave is synchronized with the receiver timing circuits. Data bits on the Receive Data line are initiated synchronously with the positive transition of the Serial Clock Receive signal and are sampled at the negative transition.

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POLLER CONTROL CODES.

The basic poller codes are eight bits long and are used for communication between the poller and the remote sites. The most significant bit, which is received last serially, is the parity bit. Parity is odd. The following paragraphs list poller codes. Table 3-6 lists control codes and their octal translation.

TABLE 3-6. CONTROL CODES

DESCRIPTION	7-BIT OCTAL TRANSLATION
Start of Message (SOM)	001
USASCII End of Message (USASCII EOM)	003
Poll	005
Acknowledge (ACK)	006
Alert	007
Reset-Write	014
Write	021
Clear-Write	022
Read	023
Synchronization (SYNC)	026
Reject	030

Start of Message.

The start of message code indicates that the next 7-bit word contains the site address. The start of message code follows the synchronization codes. It is both initiated and received by the poller.

Alert.

The poller initiates the alert code when instructed by the computer. The alert code designates a message which turns on the ALERT light on the addressed remote site Display Station.

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USASCII End of Message.

The USASCII end of message code indicates that the previous word was the last word of data. The word following the USASCII end of message code is the message parity word. This code is both initiated and received by the poller.

Message Parity.

Message parity is applicable from the start of message through the USASCII end of message code, and excludes all sync codes. The message parity code is odd. The parity bit is excluded.

Poll.

The poller initiates the poll code which designates the poll message. The poll message instructs the remote site to respond with a read message if a SEND key has been depressed or a read request active is set or a reject message if the above two conditions do not exist.

Acknowledge.

The acknowledge code originates at a remote site and designates a message which acknowledges receipt of a write, reset-write, clear-write, or alert message with no errors.

Reset-Write.

The poller transmits the reset-write code when instructed by the computer. The code designates a message which instructs the addressed display equipment to write data starting at the upper left corner. The reset-write code is followed by 12 sync codes to allow time for the entry marker to reset.

Write.

The poller initiates the write code when instructed by a computer message. The message contains data to be written on the remote crt starting at the current entry marker position.

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O

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Land)

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C

0

0

Clear-Write.

The poller initiates the clear-write code when instructed by the computer. This code designates a message which instructs the addressed Display Station to clear data from the crt and write the contained data starting at the upper left corner. The poller transmits 12 sync codes following the clear-write code to allow time for the entry marker to reset.

Read.

The read code originates at a remote site and designates a message containing data on the Display Station crt which is to be sent to the computer.

Synchronization.

The poller receives and transmits the sync code. Four sync codes are transmitted at the beginning of each message to assure receiver synchronization. These codes are not considered for purposes of message parity.

Sync codes also act as synchronization idles when contained within the message structure (reset-write and clear-write).

Reject.

The reject code originates at a remote site. This code designates a message which informs the poller that a SEND key was not depressed, a read request active was not set before receipt of the poll message, or because of a busy condition, a write, reset-write or clear-write was rejected.

SYMBOL SUBSET.

The symbol subset codes (codes with bit 5 or 6 a logical 1, but not both) are stored in the delay-line memory and specify data presented or are displayed on the crt of a Display Station at a remote site. These codes are the data sent in read, write, reset-write, and clear-write messages.

An escape code (76) followed by any code other than carriage return, E1, E2, or E3 codes will be converted to a space code (20 external BCD or 60 internal BCD). Refer to tables 3-7 and 3-8.

TABLE 3-7. SYMBOL SUBSET CONVERSION TO COMPUTER

INTERNAL CODE	EXTERNAL CODE	ESCAPE CODE RECEIVED
36	76	76 01 (CR)
37	77	76 02 (E1)
76	36	76 40 (E2)
75	35	76 41 (E3)

TABLE 3-8. SYMBOL SUBSET CONVERSION FROM COMPUTER

INTERNAL BCD	EXTERNAL BCD	ESCAPE CODE SENT
36	76	76 01 (CR)
37	77	76 02 (E1)
76	36	76 40 (E2)
75	35	76 41 (E3)

Station Address.

C

The station address code designates the remote site Display Station to which a poller is communicating. The station address in a read message is retained by the poller and sent to the computer. The next write, reset-write, or clear-write message from the computer to the poller is automatically sent to the Display Station from which the read message was received.

Site Address.

The site address code designates the remote site to which a message is addressed or from which a message is received. The remote sites polled are designated by site address switches on the Display Controller auxiliary maintenance panels. Polling takes place in numerical order.

MESSAGE FORMAT.

Messages received and sent by the poller consist of several codes. The general message format is shown in figure 3-9. All messages transmitted are preceded by four sync codes to assure synchronization recovery on the receiving end. The start of message code designates that the next code is the first word of the message. The site address and station address follow in that order. The control code defines the command or data which follows. Data to or from a remote Display Station may consist of 1 to 1040 words. The USASCII end of message code designates that the previous word was the last word of the message. The message parity code follows the end of message code. Message parity is applicable from the start of message through the end of message code inclusive and excludes all sync codes. Specific messages sent and received are listed in tables 3-9 and 3-10.

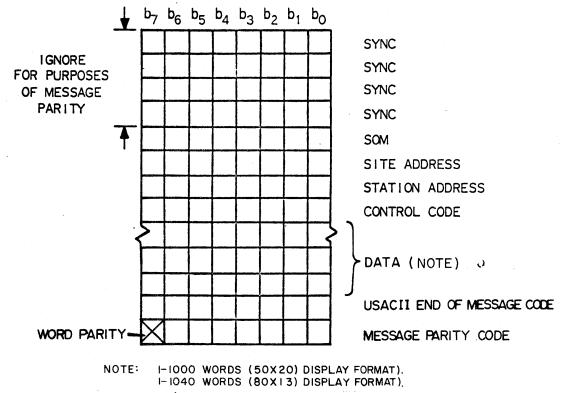


Figure 3-9. General Message Format

Synchronization.

After the Data Set turns on the Carrier On signal, data input from the Data Set is fed into a buffer register. After each data bit is received, the contents of the buffer register is examined to determine if the code is a sync code. When two

TABLE 3-9. MESSAGES SENT BY THE POLLER

	MESSAGES SENT BY THE POLLER
MESSAGE	CODE
Alert	SYNC 4 Total SYNC START OF MESSAGE SITE ADDRESS STATION ADDRESS ALERT USASCII END OF MESSAGE MESSAGE PARITY
Poll	SYNC 4 Total SYNC START OF MESSAGE SITE ADDRESS STATION ADDRESS POLL USASCII END OF MESSAGE MESSAGE PARITY
Write	SYNC 4 Total SYNC START OF MESSAGE SITE ADDRESS STATION ADDRESS WRITE 1 to 1000* words of data USASCII END OF MESSAGE MESSAGE PARITY
Clear–Write	SYNC 4 Total SYNC START OF MESSAGE SITE ADDRESS STATION ADDRESS
* 1040 w	ords if 80 by 13 display format

TABLE 3-9. MESSAGES SENT BY THE POLLER (CONT)

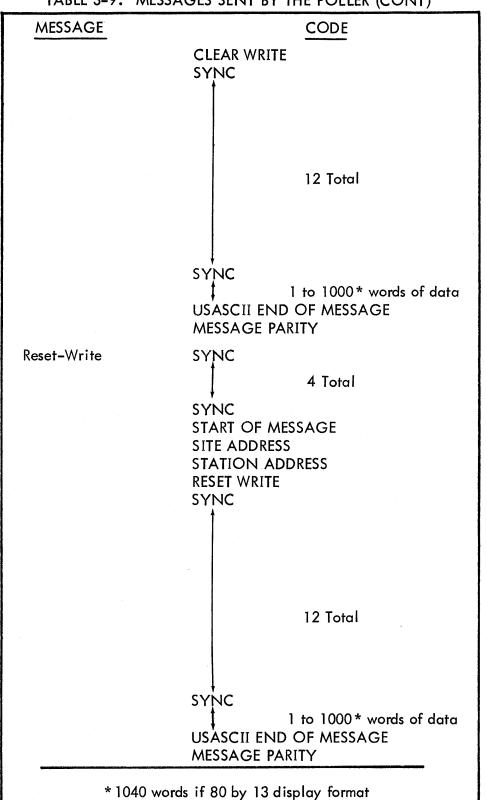
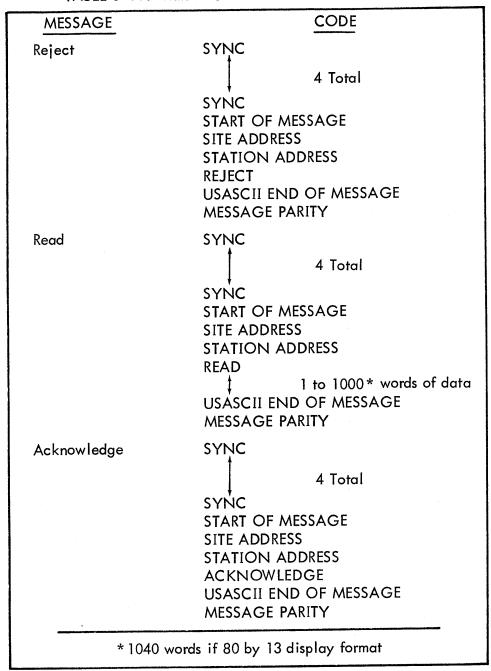


TABLE 3-10. MESSAGES RECEIVED BY THE POLLER



consecutive sync codes are detected, the poller assembles the next 8 bits and examines the contents to detect the start of message code. Unless at least two successive sync codes followed by a start of message code are detected, the poller again searches for the same pattern.

Alert Message.

The computer cannot directly send a write, reset-write, or clear-write message to be written on a remote Display Station. It can indicate to a remote display equipment that the computer has a message to be written by initiating an alert message. The alert message is initiated by the computer as an alert function to the poller.

At the time the poller would normally poll a site, it determines if an alert function was received for that site. The poller then sends an alert message instead of a poll message. The remote Display Station, upon receipt of an alert message, lights the ALERT indicator and responds with an acknowledge message. Operator action (depress SEND key) is necessary before a write message can be sent.

Polling.

The following description of the poller operation assumes that no error occurred while being transmitted over the DATA-PHONE and that the remote site is operating properly.

The poller is normally in a poll status during which time it sends periodic and sequential poll messages to the sites. If a SEND key is depressed at a site, the remote display equipment responds with a read message. If a SEND key is not depressed, the remote display equipment responds with a reject message. If a read message is received, it is transferred to the computer as a message from a local station would be transferred. The poller responds with a reset-write, write, or clear-write message addressed to the Display Station at which the SEND key was depressed. The poller sends the message to the remote Display Station. The remote display equipment responds to the reset-write, write, or clear-write message with an acknowledge message which completes the communication.

Reject Message.

The reject message is a reply from a remote site to a poll message indicating that a SEND key was not depressed. The reject message also is used to inform the poller that the previous write, clear-write, reset-write or alert function was not performed. The poller interprets this as an error.

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Read Message.

The read message is a reply from a remote site to a poll message indicating a SEND key was depressed. The data, read from the crt, begins at the upper left corner and terminates with the data subset end of message code. The read message enables send request status and the station interrupt. The computer then reads the site address and station address in the station word. After reading the station word, the computer may continue to read the rest of the data in the message or may send a write message immediately. The computer reading a data word clears the send request.

Write Message.

The write message contains data from the computer to be written on the crt of a remote Display Station, starting at the present or reset entry marker position. A write, reset-write, or clear-write message is always sent in reply to a read message (with correct parity) from a remote site. After receiving a write message with correct channel parity from the computer, the poller switches to transmit and transfers the data to a remote site.

Acknowledge Message.

If the message is an acknowledge in response to an alert message, alert request and poll interrupt status are set. The computer, upon reading status, is informed that the alert message was received by the remote Display Station. An acknowledge response to a write, reset-write, or clear-write message turns the site indicator off and the polling resumes.

ERROR PROCESSING.

Errors may arise between the sending of a message to a remote site and receiving a message from a remote site. The poller recognizes these errors:

- (a) Lack of response before time out.
- (b) Parity error in a received message.
- (c) An unexpected response such as a read message in response to a write message.

Any one of the error conditions causes the message to be retransmitted. The message is transmitted up to three times in attempting to get an error-free response. If, after three transmissions, an error-free response cannot be obtained, the poller ceases trying to communicate with that remote site.

If three attempts to successfully communicate an alert message to a remote display equipment fail, the Interrupt signal is enabled and the poller resumes polling. When the computer selects the poller, poll interrupt, poller error, and alert request status are indicated.

Three unsuccessful attempts to communicate a write, write-reset, or clear-write message to a remote site results in an Interrupt signal. Selection of the poller indicates poller error, station interrupt, and send request status. The computer must then read the station word. The computer may reread the station word, if it contained a parity error, by reconnecting to station 0. In order to clear the status bits and resume polling, it is necessary that the computer send a release function.

If a poll message cannot be successfully communicated in three attempts, the Interrupt signal is, again, enabled. When the poller is connected, it indicates send request, poll failure, and station interrupt status. The computer then reads the station word.

POLLER SYMBOL REPERTOIRE.

The poller communicates with a 7-bit code plus parity. The least significant bit (bit 0) is received first, and bit 7 is parity.

Codes with bit 6 or bit 5 (but not both) a logical 1 are stored in the delay-line memory associated with the connected poller. These codes are the data sent in read, write, reset-write, and clear-write communications with the remote sites. Remaining codes specify various functions, site address, and station address. Figure 3-10 lists symbol and function codes according to their binary translation.

3-36

				NO	TE 1		DATA	SUBSET				
			ь ₆	0	0	0	0	1	1	1	1	
		/	ь ₅	0	0	1	1	0	0	1	1	
b3	ь ₂	ь-	مراجع	0	1	0	1	0	1	0	1	
0.	0	o	0			- MINUS	+	COLON	BLANK	STATION ADDRESS ON POLL	0	
0	0	0.	1	SOM	WRITE	J (E3)	A	(CR)	/	1	1	
0	0	1	0		CLEAR- WRITE	K	В	2 (E1)	S	2	2	
0	0	1	1	U5 ASCI1 EOM	READ	L	С	3	T	3	3	DRESS
0	1	0	0			м	D	4	Ŋ	4	4	SITE ADDRESS
0	1	0	1	POLL		Z	E	5	٧	5	5	
0	. 1	1	0	ACK	SYNC	0	F	6	w	ORESS	6	
0	1	1	1	ALERT		Р	G	7	×	8 C C STATION ADDRESS	7	
1	0	0	0		REJECT	Q	н	8	Υ	8 STAT		
1	0	0	1		-	R	I	9	z	9		
1	0	1	0			٧	<	ø]	10		
1	0	1	1			\$	PERIOD	=	COMMA	11		
1	1	0	0			•) ,	≠	(12		
1	1	0	1			1	2	≤				
1	1	1	0			ı,	ESCAPE	%				
1	1	1	1			>		Е	٨			

NOTES:

- 1. Set aside for USASCII control codes.
- The lower portion of the four two-symbol data subset blocks are the interpretation of the codes when they immediately follow an escape code.

Figure 3–10. Symbol and Function Codes, Binary Translation



APPENDIX 1 CONVERSION TABLES

	en Silver en	
Adams and the second se		
		146.39 14.39
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	and the second of the second o	0.00

TABLE 1A-1. POWERS OF 2

```
2"
                     2-"
                  n
                  0
              1
                     1.0
              2
                  1
                     0.5
              4
                  2
                     0.25
              8
                  3
                     0.125
                     0.062 5
             16
                  4
             32
                  5
                     0.031 25
             64
                     0.015 625
                  6
            128
                  7
                     0.007 812 5
            256
                  8
                     0.003 906 25
            512
                  9
                     0.001 953 125
          1 024
                     0.000 976 562 5
                 10
                     0.000 488 281 25
          2 048
                 11
          4 096
                     0.000 244 140 625
                 12
                     0.000 122 070 312 5
          8 192
                 13
                     0.000 061 035 156 25
         16 384
                 14
         32 768
                     0.000 030 517 578 125
                 15
         65 536
                     0.000 015 258 789 062 5
                 16
                     0.000 007 629 394 531 25
        131 072
                 17
                     0.000 003 814 697 265 625
        262 144
                  18
                     0.000 001 907 348 632 812 5
        524 288
                  19
      1 048 576
                 20
                     0.000 000 953 674 316 406 25
                      0.000 000 476 837 158 203 125
                 21
      2 097 152
                      0.000 000 238 418 579 101 562 5
      4 194 304
                  22
                     0.000 000 119 209 289 550 781 25
      8 388 608
                  23
                      0.000 000 059 604 644 775 390 625
                 24
     16 777 216
                     0.000 000 029 802 322 387 695 312 5
     33 554 432
                 25
                     0.000 000 014 901 161 193 847 656 25
     67 108 864
                 26
                      0.000 000 007 450 580 596 923 828 125
    134 217 728
                 27
                      0.000 000 003 725 290 298 461 914 062 5
    268 435 456
                 28
                     0.000 000 001 862 645 149 230 957 031 25
    536 870 912
                  29
                     0.000 000 000 931 322 574 615 478 515 625
  1 073 741 824
                  30
                      0.000 000 000 465 661 287 307 739 257 812 5
  2 147 483 648
                  31
                      0.000 000 000 232 830 643 653 869 628 906 25
                  32
  4 294 967 296
                      0.000 000 000 116 415 321 826 934 814 453 125
                  33
  8 589 934 592
                      0.000 000 000 058 207 660 913 467 407 226 562 5
 17 179 869 184
                  34
                      0.000 000 000 029 103 830 456 733 703 613 281 25
 34 359 738 368
                  35
                      0.000 000 000 014 551 915 228 366 851 806 640 625
 68 719 476 736
                  36
                      0.000 000 000 007 275 957 614 183 425 903 320 312 5
137 438 953 472
                  37
                      0.000 000 000 003 637 978 807 091 712 951 660 156 25
274 877 906 944
                  38
                      0.000 000 000 001 818 989 403 545 856 475 830 078 125
549 755 813 888
                  39
```

TABLE 1A-2. OCTAL-DECIMAL CONVERSION TABLE (SHEET 1 OF 4)

																		1	
	0	1	2	3	4	5	6	7		0	1	2	3	4	5	6	7	_	
0000 0010	0000	0001 0009	0002 0010	0003 0011	0004 0012	0005 0013	0006 0014	0007 0015	0400 0410	0256 0264	0257 0265	0258 0266	0259 0267	0260 0268	0261 0269	0262 0270	0263 0271	0000 to	0000 to
0020	0016	0017	0018	0019	0020	0021	0022	0023	0420 0430	0272 0280	0273 0281	0274 0282	0275 0283	0276 0284	0277 0285	0278 0286	0279 0287	0777	0511
0030 0040	0024 0032	0025 0033	0026 0034	0027 0035	0028 0036	0029 0037	0030 0038	0031	0440	0288	0289	0290	0291	0292	0293	0294	0295	(Octal)	(Decima
0050 0060	0040 0048	0041 0049	0042 0050	0043 0051	0044 0052	0045 0053	0046 0054	0047 0055	0450 0460	0296 0304	0297 0305	0298 0306	0299 0307	0300 0308	0301 0309	0302 0310	0303 0311		
0070	0056	0057	0058	0059	0060	0061	0062	0063	0470	0312	0313	0314	0315	0316	0317	0318	0319	Octal	Decima
0100	0064	0065	0066	0067	0068	0069	0070	0071	0500	0320	0321	0322	0323	0324	0325	0326	0327	10000 20000	- 4096 - 8192
0110	0072	0073	0074 0082	0075 0083	0076 0084	0077 0085	0078 0086	0079 0087	0510 0520	0328 0336	0329 0337	0330 0338	0331 0339	0332 0340	0333 0341	0334 0342	0335 0343	30000	- 12288
0120 0130	0080 0088	0081 0089	0090	0091	0092	0093	0094	0095	0530	0344	0345	0346	0347	0348	0349	0350	0351		- 16384 - 20480
0140 0150	0096 0104	0097 0105	0098 0106	0099 0107	0100 0108	0101 0109	0102 0110	0103 0111	0540 0550	0352 0360	0353 0361	0354 0362	0355 0363	0356 0364	0357 0365	0358 0366	0359 0367	i .	- 24576
0160	0112	0113	0114	0115	0116	0117	0118	0119	0560	0368	0369	0370	0371	0372	0373	0374	0375	70000	- 28672
0170	0120	0121	0122	0123	0124	0125	0126	0127	0570	0376	0377	0378	0379	0380	0381	0382	0383		
0200 0210	0128 0136	0129 0137	0130 0138	0131 0139	0132 0140	0133 0141	0134 0142	0135 0143	0600	0384 0392	0385 0393	0386 0394	0387 0395	0388 0396	0389 0397	0390 0398	0391 0399	ļ	
0220	0144	0145	0146	0147	0148	0149	0150	0151	0620	0400	0401	0402	0403	0404	0405	0406	0407		
0230 0240	0152 0160	0153 0161	0154 0162	0155 0163	0156 0164	0157 0165	0158 0166	0159 0167	0630 0640	0408 0416	0409 0417	0410 0418	0411 0419	0412 0420	0413 0421	0414 0422	0415 0423		
0250	0168	0169	0170	0171	0172	0173 0181	0174 0182	0175 0183	0650 0660	0424 0432	0425 0433	0426 0434	0427 0435	0428 0436	0429 0437	0430 0438	0431 0439	1	
0260 0270	0176 0184	0177 0185	0178 0186	0179 0187	0180 0188	0189	0190	0191	0670	0440	0441	0442	0443	0444	0445	0446	0447		
0300 0310	0192 0200	0193 0201	0194 0202	0195 0203	0196 0204	0197 0205	0198 0206	0199 0207	0700 0710	0448 0456	0449 0457	0450 0458	0451 0459	0452 0460	0453 0461	0454 0462	0455 0463		
0320	0208	0209	0210	0211	0212	0213	0214	0215	0720	0464	0465	0486	0467	0468	0469	0470	0471		
0330 0340	0216 0224	0217 0225	0218 0228	0219 0227	0220 0228	0221 0229	0222 0230	0223 0231	0730	0472 0480	0473 0481	0474 0482	0475 0483	0476 0484	0477 0485	0478 0486	0479 0487		
0350	0232	0233	0234	0235	0236	0237	0238	0239	0750	0488	0489 0497	0490 0498	0491 0499	0492 0500	0493 0501	0494 0502	0495 0503		
0360 0370	0240 0248	0241 0249	0242 0250	0243 0251	0244 0252	0245 0253	0246 0254	0247 0255	0760 0770	0496 0504	0505	0506	0507	0508	0509	0510	0511	ļ	
	0																	1	
1000	2544	1	2	3	4	5	6	7	1400	0	1 0700	2	3	4 0772	5	6 0774	7	1000	0613
1010	0512 0520	0613 0521	0514 0522	0515 0523	0518 0524	0517 0525	0518 0526	0519 0527	1400 1410	0788 0778	0769 0777	0770 0778	0771 0779	0772 0780	0773 0781	0774 0782	0775 0783	1000 to	to
1020	0520 0528	0613 0521 0529	0514 0522 0530	0515 0523 0531	0518 0524 0532	0517 0525 0533	0518 0526 0534	0519 0527 0535	1410 1420	0788 0778 0784	0769 0777 0785	0770 0778 0786	0771 0779 0787	0772 0780 0788	0773 0781 0789	0774 0782 0790	0775	to 1777	to 1023
1020 1030 1040	0520 0528 0536 0544	0513 0521 0529 0537 0545	0514 0522 0530 0538 0546	0515 0523 0531 0539 0547	0518 0524 0532 0540 0548	0517 0525 0533 0541 0549	0518 0526 0534 0542 0550	0519 0527 0535 0543 0551	1410 1420 1430 1440	0768 0776 0784 0792 0800	0769 0777 0785 0793 0801	0770 0778 0786 0794 0802	0771 0779 0787 0795 0803	0772 0780 0788 0796 0804	0773 0781 0789 0797 0805	0774 0782 0790 0798 0806	0775 0783 0791 0799 0807	to	to 1023
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TABLE 1A-2. OCTAL-DECIMAL CONVERSION TABLE (SHEET 2 OF 4)

		0	1	2	3	4	5	6	7		0	1	2	3	4	5	6	7
2000 1024	2000	1624	1025	1026	1027	1028	1029	1030	1031	2400	1280	1281	1282	1283	1284	1285	1286	1287
to to	2010	1032	1033	1034	1035	1036	1037	1038	1039	2410	1288	1289	1290	1291	1292	1293	1294	1295
2777 1535	2020	1040	1041	1042	1043	1044	1045	1046	1047	2420	1296	1297	1298	1299	1300	1301	1302	1303
Octal) (Decimal)	2030	1048	1049	1050	1051	1052	1053	1054	1055	2430	1304	1305	1306	1307	1308	1309	1310	1311
	2040	1056	1057	1058	1059	1060	1061	1062	1063	2440	1312	1313	1314	1315	1316	1317	1318	1319
	2050	1064	1065	1066	1067	1068	1069	1070	1071	2450	1320	1321	1322	1323	1324	1325	1326	1327
Octal Decimal	2060	1072	1073	1074	1075	1076	1077	1078	1079	2460	1328	1329	1330	1331	1332	1333	1334	1335
10000 - 4096	2070	1080	1081	1082	1083	1084	1085	1086	1087	2470	1336	1337	1338	1339	1340	1341	1342	1343
20000 - 8192	2100	1088	1089	1090	1091	1092	1093	1094	1095	2500	1244	1245	1240	1247	1240	1240	1250	1351
30000 - 12288	2100 2100	1096	1097	1098	1099	1100	1101	1102	1103	2500 2510	1344	1345 1353	1346 1354	1347 1355	1348 1356	1349 1357	1350 1358	1359
40000 - 16384	2120	1104	1105	1106	1107	1108	1109	1110	1111	2520	1360	1361	1362	1363	1364	1365	1366	1367
50000 - 20480	2130	1112	1113	1114	1115	1116	1117	1118	1119	2530	1368	1369	1370	1371	1372	1373	1374	1375
60000 - 24576	2140	1120	1121	1122	1123	1124	1125	1126	1127	2540	1376	1377	1378	1379	1380	1381	1382	1383
70000 - 28672	2150	1128	1129	1130	1131	1132	1133	1134	1135	2550	1384	1385	1386	1387	1388	1389	1390	1391
70000 20072	2160	1136	1137	1138	1139	1140	1141	1142	1143	2560	1392	1393	1394	1395	1396	1397	1398	1399
	2170	1144	1145	1146	1147	1148	1149	1150	1151	2570	1400	1401	1402	1403	1404	1405	1406	1407
	2200	1152	1153	1154	1155	1156	1157	1158	1159	2600	1408	1409	1410	1411	1412	1413	1414	1415
	2210	1160	1161	1162	1163	1164	1165	1166	1167	2610	1416	1417	1418	1419	1420	1421	1422	1423
	2220	1168	1169	1170	1171	1172	1173	1174	1175	2620	1424	1425	1426	1427	1428	1429	1430	1431
	2230	1176	1177	1178	1179	1180	1181	1182	1183	2630	1432	1433	1434	1435	1436	1437	1438	1439
	2240	1184	1185	1186	1187	1188	1189	1190	1191	2640	1440	1441	1442	1443	1444	1445	1446	1447
	2250	1192	1193	1194	1195	1196	1197	1198	1199	2650	1448	1449	1450	1451	1452	1453	1454	1455
	2260	1200	1201	1202	1203	1204	1205	1206	1207	2660	1456	1457	1458	1459	1460	1461	1462	1463
	2270	1208	1209	1210	1211	1212	1213	1214	1215	2670	1464	1465	1466	1467	1468	1469	1470	1471
	2300	1216	1217	1218	1219	1220	1221	1222	1223	2700	1472	1473	1474	1475	1476	1477	1478	1479
	2310	1224	1225	1226	1227	1228	1229	1230	1231	2710	1480	1481	1482	1483	1484	1485	1486	1487
	2320	1232	1233	1234	1235	1236	1237	1238	1239	2720	1488	1489	1490	1491	1492	1493	1494	1495
	2330	1240	1241	1242	1243	1244	1245	1246	1247	2730	1496	1497	1498	1499	1500	1501	1502	1503
	2340	1248	1249	1250	1251	1252	1253	1254	1255	2740	1504	1505	1506	1507	1508	1519	1510	1511
	2350 2360	1256 1264	1257 1265	1258 1266	1259 1267	1260 1268	1261 1269	1262 1270	1263 1271	2750	1512 1520	1513 1521	1514 1522	1515 1523	1516 1524	1517 1525	1518 1526	1519 1527
	2370	1272	1273	1274	1275	1276	1277	1278	1279	2770	1528	1529	1530	1531	1532	1533	1534	1535
		r																
3000 1 536		0	1	2	3	4	5	6	7		0	1	2	3	4	5	6	7
3000 1 536 to to	3000 3010	1536	1537	1538	1539	1540	1541	1542	1543	3400 3410	1792	1793	1794	1795	1796	1797	1798	1799
to to	3010	1536 1544	1537 1545	1538 1546	1539 1547	1540 1548	1541 1549	1542 1550	1543 1551	3410	1792 1800	1793 1801	1794 1802	1795 1803	1796 1804	1797 1805	1798 1806	1799 1807
to to		1536	1537	1538	1539	1540	1541	1542	1543		1792	1793	1794	1795	1796	1797	1798	1799
to to 3777 204 7	3010 3020	1536 1544 1552	1537 1545 1553	1538 1546 1554	1539 1547 1555	1540 1548 1556	1541 1549 1557	1542 1550 1558	1543 1551 1559	3410 3420	1792 1800 1808	1793 1801 1809	1794 1802 1810	1795 1803 1811	1796 1804 1812	1797 1805 1813	1798 1806 1814 1822 1830	1799 1807 1815 1823 1831
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to to 3777 204 7	3010 3020 3030 3040 3050 3060	1536 1544 1552 1560 1568 1576 1584	1537 1545 1553 1561 1569 1577 1585	1538 1546 1554 1562 1570 1578 1586	1539 1547 1555 1563 1571 1579 1587	1540 1548 1556 1564 1572 1580 1588	1541 1549 1557 1565 1573 1581 1589	1542 1550 1558 1566 1574 1582 1590	1543 1551 1559 1567 1575 1583 1591	3410 3420 3430 3440 3450 3460	1792 1800 1808 1816 1824 1832 1840	1793 1801 1809 1817 1825 1833 1841	1794 1802 1810 1818 1826 1834 1842	1795 1803 1811 1819 1827 1835 1843	1796 1804 1812 1820 1828 1836 1844	1797 1805 1813 1821 1829 1837 1845	1798 1806 1814 1822 1830 1838 1846	1799 1807 1815 1823 1831 1839 1847
to to 3777 204 7	3010 3020 3030 3040 3050	1536 1544 1552 1560 1568 1576	1537 1545 1553 1561 1569 1577	1538 1546 1554 1562 1570 1578	1539 1547 1555 1563 1571 1579	1540 1548 1556 1564 1572 1580	1541 1549 1557 1565 1573 1581	1542 1550 1558 1566 1574 1582	1543 1551 1559 1567 1575 1583	3410 3420 3430 3440 3450	1792 1800 1808 1816 1824 1832	1793 1801 1809 1817 1825 1833	1794 1802 1810 1818 1826 1834	1795 1803 1811 1819 1827 1835	1796 1804 1812 1820 1828 1836	1797 1805 1813 1821 1829 1837	1798 1806 1814 1822 1830 1838	1799 1807 1815 1823 1831 1839
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TABLE 1A-2. OCTAL-DECIMAL CONVERSION TABLE (SHEET 3 OF 4)

	0	1	2	3	4	5	6	7			0	1	2	3	4	5	6	7]	
4000	2040	2040	2050	2051	2052	2052	2054	2055		4400	2204	2205	2200	9903	2200	2222	2210	2044	1	
4000	2048 2056	2049 2057	2050 2058	2051 2059	2052 2060	2053 2061	2054 2062	2055 2063		4400 4410	2304	2305	2306	2307	2308	2309	2310	2311	4000	2048
4010											2312	2313	2314	2315	2316	2317	2318	2319	to	to
4020	2064	2065	2066	2067	2068	2069	2070	2071	i .	4420	2320	2321	2322	2323	2324	2325	2326	2327	4777	2559
4030	2072	2073	2074	2075	2076	2077	2078	2079		4430	2328	2329	2330	2331	2332	2333	2334	2335	(Octal)	(Decim
4040	2080	2081	2082	2083	2084	2085	2086	2087		4440	2336	2337	2338	2339	2340	2341	2342	2343	(UCIAI)	(nsciii
4050	2088	2089	2090	2091	2092	2093	2094	2095		4450	2344	2345	2346	2347	2348	2349	2350	2351		
4060	2096	2097	2098	2099	2100	2101	2102	2103		4460	2352	2353	2354	2355	2356	2357	2358	2359	ł	
4070	2104	2105	2106	2107	2108	2109	2110	2111		4470	2360	2361	2362	2363	2364	2365	2366	2367	Octal	Decimal
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4100	2112	2113	2114	2115	2116	2117	2118	2119		4500	2368	2369	2370	2371	2372	2373	2374	2375	1	
4110	2120	2121	2122	2123	2124	2125	2126	2127		4510	2376	2377	2378	2379	2380	2381	2382	2383		- 8192
4120	2128	2129	2130	2131	2132	2133	2134	2135		4520	2384	2385	2386	2387	2388	2389	2390	2391	1	- 12288
4130	2136	2137	2138	2139	2140	2141	2142	2143		4530	2392	2393	2394	2395	2396	2397	2398	2399	40000	- 16384
4140	2144	2145	2146	2147	2148	2149	2150	2151		4540	2400	2401	2402	2403	2404	2405	2406	2407	50000	- 20480
4150	2152	2153	2154	2155	2156	2157	2158	2159		4550	2408	2409	2410	2411	2412	2413	2414	2415	60000	- 24576
4160	2160	2161	2162	2163	2164	2165	2166	2167		4560	2416	2417	2418	2419	2420	2421	2422	2423	1	- 28672
4170	2168	2169	2170	2171	2172	2173	2174	2175		4570	2424	2425	2426	2427	2428	2429	2430	2431	70000	- 20012
4170	2100	2103	2170	2171	2112	2173	2174	21/5		4370	2424	2423	2420	2421	2420	2423	2430	2431		
4200	2176	2177	2178	2179	2180	2181	2182	2102		4600	2422	2422	2434	2435	2436	2437	2438	2420		
4210	2184	2185	2186	2179	2188	2189		2183		4600	2432	2433						2439		
4210	2192	2193	2194	2195		2189	2190	2191		4610	2440	2441	2442	2443	2444	2445	2446	2447		
					2196		2198	2199		4620	2448	2449	2450	2451	2452	2453	2454	2455	ŀ	
4230	2200	2201	2202	2203	2204	2205	2206	2207		4630	2456	2457	2458	2459	2460	2461	2462	2463		
4240	2208	2209	2210	2211	2212	2213	2214	2215		4640	2464	2465	2466	2467	2468	2469	2470	2471		
4250	2216	2217	2218	2219	2220	2221	2222	2223		4650	2472	2473	2474	2475	2476	2477	2478	2479		
4260	2224	2225	2226	2227	2228	2229	2230	2231		4660	2480	2481	2482	2483	2484	2485	2486	2487		
4270	2232	2233	2234	2235	2236	2237	2238	2239		4670	2488	2489	2490	2491	2492	2493	2494	2495		
	l										1								1	
4300	2240	2241	2242	2243	2244	2245	2246	2247		4700	2496	2497	2498	2499	2500	2501	2502	2503		
4310	2248	2249	2250	2251	2252	2253	2254	2255		4710	2504	2505	2506	2507	2508	2509	2510	2511		
4320	2256	2257	2258	2259	2260	2261	2262	2263		4720	2512	2513	2514	2515	2516	2517	2518	2519		
4330	2264	2265	2266	2267	2268	2269	2270	2271		4730	2520	2521	2522	2523	2524	2525	2526	2527		
4340	2272	2273	2274	2275	2276	2277	2278	2279	1 1	4740	2528	2529	2530	2531	2532	2533	2534	2535		
4350	2280	2281	2282	2283	2284	2285	2286	2287		4750	2536	2537	2538	2539	2540	2541	2542	2543		
4360		2289	2290	2291					: 1		2000				2548				I	
	2788							2295		4760 l	2544	7505	7546						1	
4370	2288 2296	2297	2298	2299	2292 2300	2293 2301	2294 2302	2295 2303		4760 4770	2544 2552	2545 2553	2546 2554	2547 2555	2556	2549 2557	2550 2558	2551 2559		
	2296	2297	2298	2299	2300	2301	2302	2303			2552	2553	2554	2555	2556	2557	2558	2559	5000	256
4370	2296 O	1	2298	2299	2300	2301	2302	2303 7		4770	2552 O	2553	2554 2 2818 2826	2555 3	2556 4	2557	2558 6	2559 7	5000	
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5000 5010 5020 5030 5050 5060 5070 5100 5110 5120 5130 5110 5155 5170 5200 5210 5220 5220 5220 5220 5220 522	2560 2560 2568 2576 2582 2600 2608 2616 2624 2632 2664 2652 2664 2672 2684 2712 2720 2728 2736 2744 2752 2764 2772 2788 2778	2561 2569 2577 2585 2593 2601 2609 2617 2625 2633 2641 2649 2665 2673 2681 2705 2713 2721 2729 2737 2745 2753 2765 2765 2775 2765 2775 2765 2777	2298 2 2562 2570 2578 2586 2694 2602 2610 2618 26264 2634 2662 2634 2662 2674 2682 2796 2714 2722 2730 2738 2746	2299 2563 2571 2579 2587 2587 2603 2611 2619 2627 2635 2643 2651 2692 2667 2675 2683 2691 2723 2731 2739 2747 2755 2763	2564 2582 2580 2588 2588 2612 2620 2620 2628 2636 2644 2652 2664 2768 2716 2716 2716 2716 2716 2716 2716 2716	2565 2573 2581 2589 25897 2605 2613 2621 2629 2637 2645 2653 26645 2665 2677 2685 2701 2709 2717 2725 2733 2741 2748 2757 2765 2763 2763 2763 2763 2763 2763 2763 2763	2566 2566 2574 2582 2590 2614 2622 2630 2638 2638 2646 2654 2667 2670 2710 2718 2726 2750 2750 2758 2762 2758 2768	2303 7 2567 2575 2583 2591 2615 2623 2631 2639 2637 2679 2687 2695 2703 2711 2719 2727 2735 2743 2751 2759 2783		5400 5410 5420 5430 5440 5450 5540 5540 5550 5550 555	2816 2816 2812 2842 2842 2848 2856 2864 2872 2880 2910 2920 2928 2936 2944 2952 2960 2968 2976 2984 2992 3000 3016 3016 3014 3014 3014 3014 3014 3014 3014 3014	2817 2817 2825 2833 2841 2867 2865 2873 2861 2892 2912 2929 2937 2945 2952 2929 2937 2945 2953 2961 2969 2977 3009 3017 3009 3013	2818 2826 2834 2842 2850 2858 2866 2874 2889 2990 2993 2938 2946 2952 2970 2978 2978 2978 2989 2994 3002	2819 2827 2835 2843 2843 2859 2867 2875 2893 2907 2915 2923 2931 2939 2947 2955 2963 2971 2979 3003	2820 2820 2828 2836 2844 2852 2860 2868 2876 2992 2992 2994 2932 2940 2948 2956 2964 2972 2989 2988 2996 3004	2557 5 2821 2829 2837 2845 2853 2861 2869 2877 2885 2993 2901 2909 2917 2925 2933 2941 2949 2957 2983 2991 3005 3013 3021 3023	2858 2822 2830 2838 2846 2862 2878 2898 2990 2910 2912 2914 2926 2934 2942 2950	2823 2831 2839 2847 2855 2863 2871 2879 2890 2911 2919 2927 2935 2943 2951 2951 2967 2975 2983 3007 3015 3023 3031 3031	to 5777	to 307

TABLE 1A-2. OCTAL-DECIMAL CONVERSION TABLE (SHEET 4 OF 4)

		0	1	2	3	4	5	6	7			0	1	2	3	4	5	6	7
										Γ							2000	2224	2225
6000 3072	6000	3072	3073	3074	3075 3083	3076	3077 3085	3078 3086	3079 3087		6400 6410	3328 3336	3329 3337	3330 3338	3331 3339	3332 3340	3333 3341	3334 3342	3335 3343
to to	6010 6020	3080 3088	3081 3089	3082 3090	3091	3084 3092	3093	3094	3095		6420	3344	3345	3346	3347	3348	3349	3350	3351
6777 3583	6030	3096	3097	3098	3099	3100	3101	3102	3103		6430	3352	3353	3354	3355	3356	3357	3358	3359
Octal) (Decimal)	6040	3104	3105	3106	3107	3108	3109	3110	3111		6440	3360	3361	3362	3363	3364	3365	3366	3367
	6050	3112	3113	3114	3115	3116	3117	3118	3119		6450	3368	3369	3370	3371	3372	3373	3374	3375
Out to Destroit	6060	3120	3121	3122	3123	3124	3125	3126	3127		6460	3376	3377	3378	3379	3380	3381	3382 3390	3383 3391
Octal Decimal	6070	3128	3129	3130	3131	3132	3133	3134	3135		6470	3384	3385	3386	3387	3388	3389	3390	3331
10000 - 4096 20000 - 8192	6100	3136	3137	3138	3139	3140	3141	3142	3143		6500	3392	3393	3394	3395	3396	3397	3398	3399
30000 - 12288	6110	3144	3145	3146	3147	3148	3149	3150	3151		6510	3400	3401	3402	3403	3404	3405	3406	3407
40000 - 16384	6120	3152	3153	3154	3155	3156	3157	3158	3159		6520	3408	3409	3410	3411	3412	3413	3414	3415
50000 - 20480	6130	3160	3161	3162	3163	3164	3165	3166	3167		6530	3416	3417	3418	3419	3420	3421	3422	3423
60000 - 24576	6140 6150	3168 3176	3169 3177	3170 3178	3171 3179	3172 3180	3173 3181	3174 3182	3175 3183		6540 6550	3424 3432	3425 3433	3426 3434	3427 3435	3428 3436	3429 3437	3430 3438	3431 3439
70000 - 28672	6160	3184	3185	3186	3187	3188	3189	3190	3191		6560	3440	3441	3442	3443	3444	3445	3446	3447
70000 20012	6170	3192	3193	3194	3195	3196	3197	3198	3199		6570	3448	3449	3450	3451	3452	3453	3454	3455
	6200	3200	3201	3202	3203	3204	3205	3206	3207		6600	3456	3457	3458	3459	3460	3461	3462	3463
	6210	3208	3209	3210	3211	3212	3213	3214	3215		6610	3464	3465	3466	3467	3468	3469	3470	3471
	6220	3216	3217	3218	3219	3220	3221	3222	3223		6620	3472	3473	3474	3475	3476	3477	3478	3479
	6230	3224	3225	3226	3227	3228	3229	3230	3231		6630	3480	3481	3482	3483	3484	3485	3486	3487
	6240 6250	3232 3240	3233 3241	3234 3242	3235 3243	3236 3244	3237 3245	3238 3246	3239 3247		6640 6650	3488 3496	3489 3497	3490 3498	3491 3499	3492 3500	3493 3501	3494 3502	3495 3503
	6260	3248	3249	3250	3251	3252	3253	3254	3255		6660	3504	3505	3506	3507	3508	3509	3510	3511
	6270	3256	3257	3258	3259	3260	3261	3262	3263		6670	3512	3513	3514	3515	3516	3517	3518	3519
	6300	3264	3265	3266	3267	3268	3269	3270	3271		6700	3520	3521	3522	3523	3524	3525	3526	3527
	6310	3272	3273	3274	3275	3276	3277	3278	3279		6710	3528	3529	3530	3531	3532	3533	3534	3535
	6320	3280	3281	3282	3283	3284	3285	3286	3287		6720	3536	3537	3538	3539	3540	3541	3542	3543
	6330	3288	3289	3290	3291	3292	3293	3294	3295 3303		6730	3544 3552	3545	3546	3547	3548	3549	3550	3551
	6340	3296	3297	3298	3299	3300	3301	3302		1 1			3553	3554	3555	3556	3557	3558	3559
		2204	2205	2206	2207	2200	2200				6740				2562	3564		3566	2567
	6350 6360	3304 3312	3305 3313	3306 3314	3307 3315	3308 3316	3309 3317	3310	3311		6740 6750 6760	3560 3568	3561	3562	3563 3571	3564 3572	3565 3573	3566 3574	3567 3575
	6360 6370	3304 3312 3320	3305 3313 3321	3306 3314 3322	3307 3315 3323	3308 3316 3324	3309 3317 3325				6750	3560 3568 3576	3561 3569 3577	3562 3570 3578	3571 3579	3572 3580	3565 3573 3581	3574 3582	3575 3583
	6360	3312	3313	3314	3315	3316	3317	3310 3318	3311 3319		6750 6760	3560 3568	3561 3569	3562 3570	3571	3572	3565 3573	3574	3575
7000 3584	6360 6370 7000	3312 3320 O 3584	3313 3321 1 3585	3314 3322 2 3586	3315 3323 3 3587	3316 3324 4 3588	3317 3325 5 3589	3310 3318 3326 6 3590	3311 3319 3327 7 3591		6750 6760 6770 7400	3560 3568 3576 O	3561 3569 3577 1 3841	3562 3570 3578 2 3842	3571 3579 3	3572 3580 4 3844	3565 3573 3581 5	3574 3582 6 3846	3575 3583 7 3847
to to	7000 7010	3312 3320 O 3584 3592	3313 3321 1 3585 3593	3314 3322 2 3586 3594	3315 3323 3 3587 3595	3316 3324 4 3588 3496	3317 3325 5 3589 3497	3310 3318 3326 6 3590 3598	3311 3319 3327 7 3591 3599		6750 6760 6770 7400 7410	3560 3568 3576 O 3840 3848	3561 3569 3577 1 3841 3849	3562 3570 3578 2 3842 3850	3571 3579 3 3 3843 3851	3572 3580 4 3844 3852	3565 3573 3581 5 3845 3853	3574 3582 6 3846 3854	3575 3583 7 3847 3855
to to 7777 4095	7000 7010 7020	3312 3320 O 3584 3592 3600	3313 3321 1 3585 3593 3601	3314 3322 2 3586 3594 3602	3315 3323 3 3587 3595 3603	3316 3324 4 3588 3496 3604	3317 3325 5 3589 3497 3605	3310 3318 3326 6 3590 3598 3606	3311 3319 3327 7 3591 3599 3607		6750 6760 6770 7400 7410 7420	3560 3568 3576 O 3840 3848 3856	3561 3569 3577 1 3841 3849 3857	3562 3570 3578 2 3842 3850 3858	3571 3579 3 3 3843 3851 3859	3572 3580 4 3844 3852 3860	3565 3573 3581 5 3845 3853 3861	3574 3582 6 3846 3854 3862	3575 3583 7 3847 3855 3863
to to	7000 7010 7020 7030	3312 3320 O 3584 3592 3600 3608	3313 3321 1 3585 3593 3601 3609	3314 3322 2 3586 3594 3602 3610	3315 3323 3 3587 3595	3316 3324 4 3588 3496	3317 3325 5 3589 3497	3310 3318 3326 6 3590 3598	3311 3319 3327 7 3591 3599		6750 6760 6770 7400 7410	3560 3568 3576 O 3840 3848	3561 3569 3577 1 3841 3849	3562 3570 3578 2 3842 3850	3571 3579 3 3 3843 3851	3572 3580 4 3844 3852	3565 3573 3581 5 3845 3853	3574 3582 6 3846 3854	3575 3583 7 3847 3855
to to 7777 4095	7000 7010 7020	3312 3320 O 3584 3592 3600	3313 3321 1 3585 3593 3601	3314 3322 2 3586 3594 3602	3315 3323 3 3587 3595 3603 3611	3316 3324 4 3588 3496 3604 3612	3317 3325 5 3589 3497 3605 3613 3621 3629	3310 3318 3326 6 3590 3598 3608 3614 3622 3630	3311 3319 3327 7 3591 3599 3607 3615		6750 6760 6770 7400 7410 7420 7430 7440 7450	3560 3568 3576 O 3840 3848 3856 3864 3872 3880	3561 3569 3577 1 3841 3849 3857 3865 3873 3881	3562 3570 3578 2 3842 3850 3858 3866 3874 3882	3571 3579 3 3843 3851 3859 3867 3875 3883	3572 3580 4 3844 3852 3860 3868 3876 3884	3565 3573 3581 5 3845 3853 3861 3869 3877 3885	3574 3582 6 3846 3854 3862 3870 3878 3886	3575 3583 7 3847 3855 3863 3871 3879 3887
to to 7777 4095	7000 7010 7020 7030 7040 7050 7060	3312 3320 0 3584 3592 3600 3608 3616 3624 3632	3313 3321 1 3585 3593 3601 3609 3617 3625 3633	3314 3322 2 3586 3594 3602 3610 3618 3626 3634	3315 3323 3 3587 3595 3603 3611 3619 3627 3635	3316 3324 4 3588 3496 3604 3612 3620 3628 3636	3317 3325 5 3589 3497 3605 3613 3621 3629 3637	3310 3318 3326 6 3590 3598 3608 3614 3622 3630 3638	3311 3319 3327 7 3591 3599 3607 3615 3623 3631 3639		7400 7410 7420 7430 7450 7460	3560 3568 3576 0 3840 3848 3856 3864 3872 3880 3888	3561 3569 3577 1 3841 3849 3857 3865 3873 3881 3889	3562 3570 3578 2 3842 3850 3858 3866 3874 3882 3890	3571 3579 3 3843 3851 3859 3867 3875 3883 3891	3572 3580 4 3844 3852 3860 3868 3876 3884 3892	3565 3573 3581 5 3845 3853 3861 3869 3877 3885 3893	3574 3582 6 3846 3854 3862 3870 3878 3886 3894	3575 3583 7 3847 3855 3863 3871 3879 3887 3895
to to 7777 4095	7000 7010 7020 7030 7040 7050	3312 3320 0 3584 3592 3600 3608 3616 3624	3313 3321 1 3585 3593 3601 3609 3617 3625	3314 3322 2 3586 3594 3602 3610 3618 3626	3315 3323 3 3587 3595 3603 3611 3619 3627	3316 3324 4 3588 3496 3604 3612 3620 3628	3317 3325 5 3589 3497 3605 3613 3621 3629	3310 3318 3326 6 3590 3598 3608 3614 3622 3630	3311 3319 3327 7 3591 3599 3607 3615 3623 3631		6750 6760 6770 7400 7410 7420 7430 7440 7450	3560 3568 3576 O 3840 3848 3856 3864 3872 3880	3561 3569 3577 1 3841 3849 3857 3865 3873 3881	3562 3570 3578 2 3842 3850 3858 3866 3874 3882	3571 3579 3 3843 3851 3859 3867 3875 3883	3572 3580 4 3844 3852 3860 3868 3876 3884	3565 3573 3581 5 3845 3853 3861 3869 3877 3885	3574 3582 6 3846 3854 3862 3870 3878 3886	3575 3583 7 3847 3855 3863 3871 3879 3887
to to 1777 4095	7000 7010 7020 7040 7050 7060 7070 7100	3312 3320 0 3584 3592 3600 3608 3616 3624 3632 3640 3648	3313 3321 1 3585 3593 3601 3609 3617 3623 3633 3641 3649	3314 3322 2 3586 3594 3602 3610 3618 3626 3634 3642 3650	3315 3323 3587 3595 3603 3611 3619 3627 3635 3643 3651	3316 3324 4 3588 3496 3604 3612 3620 3628 3636 3644 3652	3317 3325 5 3589 3497 3605 3613 3621 3629 3637 3645 3653	3310 3318 3326 6 3590 3598 3606 3614 3622 3630 3638 3646	3311 3319 3327 7 3591 3599 3607 3615 3623 3631 3639 3647 3655		7400 7410 7420 7430 7440 7450 7470 7500	3560 3568 3576 O 3840 3848 3856 3864 3872 3880 3888 3896	3561 3569 3577 1 3841 3849 3857 3865 3873 3881 3889 3897	3562 3570 3578 2 3842 3850 3858 3866 3874 3882 3890 3898 3906	3 3843 3851 3859 3867 3875 3883 3891 3899	3572 3580 4 3844 3852 3860 3868 3876 3884 3892 3900 3908	3565 3573 3581 5 3845 3853 3861 3869 3877 3885 3893 3901 3909	3574 3582 6 3846 3854 3862 3870 3878 3886 3894 3902	3575 3583 7 3847 3855 3863 3871 3879 3887 3993 3911
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to to 7777 4095	7000 7010 7030 7040 7050 7060 7070 7100 7110 7120 7130 7140 7150 7210 7220 7230 7240 7250 7270	3312 3320 0 3584 3592 3600 3608 3618 3632 3640 3652 3672 3680 3704 3712 3720 3728 3736 3744 3752 3786 3768 3768 3768	3313 3321 1 3585 3593 3601 3609 3617 3625 3633 3641 3649 3657 3765 3773 3721 3721 3721 3721 3721 3721 3737 3745 3753 3763 3763 3763 3763 3763 3763 376	3314 3322 2 3586 3594 3602 3610 3618 3626 3658 3654 3658 3764 3754 3720 3730 3714 3720 3730 3746 3754 3770	3315 3323 3587 3595 3601 3611 3619 3635 3643 3651 3659 3707 3715 3723 3731 3739 3747 3755 3773 3775	3316 3324 4 3588 3496 3604 3620 3628 3636 3644 3652 3660 3708 3716 3724 3732 3740 3740 3744 3756 3754 3772 3780	3317 3325 5 3589 3497 3605 3613 3621 3637 3685 3693 3701 3709 3717 3725 3733 3741 3749 3757 3773	3310 3318 3326 6 3590 3598 3614 3622 3630 3638 3646 3654 3670 3710 3718 3728 3758 3758 3774 3782	3311 3319 3327 7 3591 3599 3607 3615 3623 3639 3647 3655 3663 3679 3687 3711 3719 3727 3735 3743 3751 3759 3775		7400 7410 7410 7410 7420 7430 7440 7440 7450 7460 7500 7510 7550 7550 7560 7570 7610 7610 7620 7680 7680 7680 7680 7680 7680	3560 3568 3576 0 3840 3840 3848 3856 3864 3872 3928 3934 3912 3928 3934 3952 3960 3968 3978 4000 4018 4002 4002	3561 3569 3577 1 1 3841 3849 3857 3865 3873 3993 3993 3993 3993 3993 3993 4001 4017 4025 4033	3562 3578 3578 2 3842 3850 3858 3866 3874 3930 3938 3938 3934 3954 3954 3970 3978 3978 4002 4014 4018 4028	3 3 3843 3851 3859 3867 3873 3893 3997 3913 3931 3931 3935 3955 3963 3971 3978 4003 4011 4012 4012 4035	3572 3580 4 3844 3852 3860 3868 3876 3989 3916 3924 3932 3948 3956 3958 3958 3958 4004 4012 4028 4038	3565 3573 3581 5 3845 3853 3861 3869 3877 3985 3993 3941 3995 3997 4005 4013 4028 4029	3574 3582 6 3846 3854 3862 3870 3878 3986 3998 3998 3934 3950 3958 3958 3958 3958 3958 4006 4014 4022 4030	3875 3583 7 3847 3855 3863 3871 3879 3993 3991 3913 3951 3959 3957 3953 3959 4007 4015 4023 4031
to to 7777 4095	7000 7010 7020 7030 7040 7050 7060 7070 7110 7120 7130 7140 7150 7160 7170 7210 7220 7230 7240 7250 7260 7270	3312 3320 0 3584 3592 3600 3616 3624 3632 3640 3658 3658 3672 3680 3704 3712 3728 3720 3728 3736 3744 3752 3760 3768	3313 3321 1 3585 3593 3601 3633 3641 3649 3657 3663 3673 3681 3683 3775 3721 3729 3737 3745 3753 3763 3778	3314 3322 2 3586 3594 3602 3610 3618 3626 3634 3650 3858 3682 3698 3708 3714 3722 3730 3714 3754 3754 3776 3778	3315 3323 3587 3595 3603 3635 3643 3651 3659 3675 3675 3675 3675 3773 3715 3723 3731 3747 3755 3773 3779 3779	3316 3324 4 3588 3496 3604 3620 3628 3636 3636 3636 3684 3692 3700 3718 3724 3732 3740 3752 3764 3772 3780 3788	3317 3325 5 3589 3497 3605 3637 3645 3663 3663 3667 3677 3709 3717 3725 3733 3741 3757 3765 3763 3763 3763 3763 3763 3763	3310 3318 3326 6 3590 3598 3614 3622 3638 3646 3654 3670 3710 3718 3728 3734 3750 3758 3758 3758 3774	3311 3319 3327 7 3591 3599 3697 3615 3623 3631 3639 3647 3695 3693 3679 3711 3719 3727 3735 3751 3751 3753 3751 3753 3751 3753		7400 7410 7410 7410 7410 7410 7420 7430 7440 7550 7550 7550 7550 7560 7570 7600 7610 7620 7630 7640 7680 7680 7680 7680 7680 7680 7680 768	3560 3568 3576 0 3840 3848 3848 3856 3864 3872 3928 3928 3928 3928 3928 3952 3952 3960 3968 3976 4000 4008 4004 4014 4024 4032 4040	3561 3569 3577 1 3841 3849 3857 3865 3873 3983 3993 3913 3929 3937 3945 3945 3945 3945 3945 3945 3945 3945	3562 3570 3578 2 3842 3850 3858 3868 3873 3994 3914 3922 3930 3938 3943 3943 3954 4010 4010 4010 4010 4018 4028	3571 3579 3 3843 3851 3853 3867 3875 3893 3907 3915 3923 3939 3947 3953 3953 3963 3971 3978 3987 3987 4003 4011 4019 4014 4027	3572 3580 4 3844 3852 3860 3876 3892 3900 3918 3918 3932 3940 3948 3954 3980 3984 4012 4024 4028 4038 4044	3565 3573 3581 5 3845 3853 3861 3869 3877 3985 3997 3993 3997 4005 4013 4021 4037 4045	3574 3582 66 3846 3854 3862 3878 3894 3990 3910 3918 3924 3950 3958 3958 3958 4008 4014 4012 4012 4038 4048	3875 3583 7 3847 3863 3863 3887 3895 3993 3991 3911 3919 3927 395 3967 3983 3991 3993 3993 3994 3995 3993 3994 4017 4015 4023 4039 4047
to to 7777 4095	7000 7010 7020 7030 7040 7050 7060 7110 7120 7130 7140 7150 7160 7210 7220 7230 7240 7250 7260 7270	3312 3320 0 3584 3592 3600 3616 3624 3632 3640 3648 3656 3688 3696 3704 3712 3720 3728 3736 3760 3768 3764 3776 3776 3776	3313 3321 1 3585 3593 3601 3623 3633 3633 3641 3649 3657 3683 3681 3773 3721 3729 3737 3745 3753 3761 3768 3773 3775 3776 3776 3776	3314 3322 3588 3594 3602 3618 3624 3634 3650 3658 3668 3698 3706 3718 3718 3718 3718 3770 3778	3315 3323 3587 3595 3603 3619 3627 3635 3659 3667 3673 3683 3691 3715 3723 3731 3739 3755 3763 3771	3316 3324 4 3588 3498 3604 3612 3620 3628 3636 3636 3684 3692 3700 3718 3724 3732 3740 3756 3764 3772 3788	3317 3325 5 3589 3497 3605 3621 3623 3637 3645 3683 3701 3709 3717 3725 3733 3741 3757 3765 3773 3789 3789	3310 3318 3326 5590 3598 3598 3698 3614 3622 3630 3638 3646 3678 3702 3710 3718 3728 3734 3742 3750 3774 3782 3774	3311 3319 3327 7 3591 3599 3607 3615 3623 3631 3639 3647 3655 3663 3703 3711 3719 3727 3743 3751 3775 3787 3775		7400 7400 7410 7410 7420 7430 7440 7450 7450 7550 7550 7550 7550 7560 7570 7600 7620 7630 7660 7670 7700 7700 7710 7710	3560 3568 3576 3680 3840 3848 3856 3864 3872 3880 3888 3994 3912 3920 3928 3936 3936 4000 4016 4024 4040 4044 4040	1 1 3841 3841 3849 3857 3865 3873 3881 3889 3993 3913 3921 3923 3945 3953 3961 3963 4001 4009 4007 4002 4003 4004 4040 4040 4040	3562 3578 3578 3842 3850 3858 3866 3874 3982 3998 3914 3914 3914 3954 3954 3954 4002 4010 4018 4028 4038 4048 4042 4042 4044	3571 3579 3 3843 3851 3859 3875 3883 3891 3915 3923 3937 3953 3953 3963 3971 3979 3987 3997 3997 4003 4011 4027 4027 4034 4043 4043	3572 3580 4 3844 3852 3860 3876 3894 3916 3924 3932 3940 3948 3958 3964 4012 4020 4028 4038 4038 4038 4038 4044 4044 4052	3665 3573 3581 5 3845 3863 3863 3893 3991 3995 3997 3995 3997 4005 4013 4021 4029 4037 4046 4045	3574 3582 6 3846 3854 3862 3878 3898 3910 3918 3928 3950 3956 3956 3974 4022 4030 4014 4022 4030 4038 4048 4048	3875 3583 7 3847 3855 3863 3879 3897 3993 3991 3993 3991 3995 3995 3995 4007 4015 4023 4031 4031
to to 7777 4095	7000 7010 7030 7040 7050 7060 7070 7100 7110 7120 7130 7140 7150 7210 7220 7230 7240 7250 7270 7300 7310 7310 7320 7330	3312 3320 0 3584 3592 3600 3608 3618 3632 3640 3632 3643 3656 3704 3712 3720 3728 3736 3744 3752 3786 3786 3786 3786 3786 3786 3786 3786	3313 3321 1 3585 3593 3601 3609 3617 3623 3633 3641 3649 3657 3763 3773 3781 3721 3721 3721 3721 3721 3737 3781 3781 3783 3781 3783 3783 378	3314 3322 2 3586 3594 3602 3610 3618 3626 3658 3654 3658 3754 3754 3770 3778 3786 3770 3778 3784 3784 3784 3784 3784 3784 3784	3315 3323 3587 3595 3601 3611 3619 3627 3635 3643 3651 3659 3707 3715 3723 3731 3731 3731 3747 3785 3771 3787 3787 3787 3787 3787 3787 3787	3316 3324 4 3588 3496 3604 3620 3628 3636 3644 3652 3660 3708 3716 3724 3732 3732 3740 3740 3740 3740 3784 3786 3786 3786 3786 3786 3786 3786 3786	3317 3325 5 3589 3497 3605 3613 3621 3637 3645 3653 3697 3797 3793 3793 3793 3793 3781 3783 3781 3789 3787 3781 3789 3787 3781 3789 3787 3787 3787 3787 3787 3787 3787	3310 3318 3326 6 3590 3598 3614 3622 3630 3638 3646 3654 3667 3678 3702 3710 3718 3728 3758 3758 3774 3782 3790 3798 3798 3798	3311 3319 3327 7 3591 3599 3607 3615 3623 3639 3647 3655 3663 3679 3711 3719 3727 3735 3743 3751 3759 3791 3791 3793 3793 3791 3793 3793 379		7400 7410 7410 7410 7420 7430 7440 7440 7450 7460 7500 7550 7550 7560 7570 7610 7610 7610 7620 7680 7680 7680 7680 7710 7710	3560 3568 3576 0 3840 3848 3848 3856 3864 3872 3928 3938 3912 3928 3938 3934 4092 4002 4008 4018 4024 4048 4048 4048 4048	3561 3569 3577 1 1 3841 3849 3857 3865 3873 3893 3993 3993 3993 3993 3993 4001 4017 4025 4033 4041 4049 4057	3562 3578 3578 2 3842 3850 3858 3868 3878 3994 3914 3922 3930 3938 3943 3944 4010 4010 4010 4010 4014 4028	3571 3579 3 3843 3851 3853 3867 3875 3893 3907 3915 3923 3939 3947 3953 3953 3963 3971 3978 3987 3987 4003 4011 4019 4014 4027	3572 3580 4 3844 3852 3860 3876 3892 3900 3918 3918 3932 3940 3948 3954 3980 3984 4012 4024 4028 4038 4044	3565 3573 3581 5 3845 3853 3861 3869 3877 3985 3997 3993 3997 4005 4013 4021 4037 4045	3574 3582 66 3846 3854 3862 3878 3894 3990 3910 3918 3924 3950 3958 3958 3958 4008 4014 4012 4012 4038 4048	3875 3583 7 3847 3863 3863 3887 3895 3993 3991 3911 3919 3927 395 3967 3983 3991 3993 3993 3994 3995 3993 3994 4017 4015 4023 4039 4047
to to 7777 4095	7000 7010 7020 7030 7040 7050 7060 7110 7120 7130 7140 7150 7160 7210 7220 7230 7240 7250 7260 7270	3312 3320 0 3584 3592 3600 3616 3624 3632 3640 3648 3656 3688 3696 3704 3712 3720 3728 3736 3760 3768 3764 3776 3776 3776	3313 3321 1 3585 3593 3601 3623 3633 3633 3641 3649 3657 3683 3681 3773 3721 3729 3737 3745 3753 3761 3768 3773 3775 3776 3776 3776	3314 3322 3588 3594 3602 3618 3624 3634 3650 3658 3668 3698 3706 3718 3718 3718 3718 3770 3778	3315 3323 3587 3595 3603 3619 3627 3635 3659 3667 3673 3683 3691 3715 3723 3731 3739 3755 3763 3771 3775	3316 3324 4 3588 3498 3604 3612 3620 3628 3636 3636 3684 3692 3700 3718 3724 3732 3740 3756 3764 3772 3788	3317 3325 5 3589 3497 3605 3613 3621 3623 3637 3645 3683 3701 3709 3717 3725 3733 3741 3757 3765 3773 3789 3789	3310 3318 3326 5590 3598 3598 3698 3614 3622 3630 3638 3646 3678 3702 3710 3718 3728 3734 3742 3750 3774 3782 3774	3311 3319 3327 7 3591 3599 3607 3615 3623 3631 3639 3647 3655 3663 3703 3711 3719 3727 3743 3751 3775 3787 3775		7400 7400 7410 7410 7420 7430 7440 7450 7450 7550 7550 7550 7550 7560 7570 7600 7620 7630 7660 7670 7700 7700 7710 7710	3560 3568 3576 3680 3840 3848 3856 3864 3872 3880 3888 3994 3912 3920 3928 3936 3936 4000 4016 4024 4040 4044 4040	1 1 3841 3841 3849 3857 3865 3873 3881 3889 3993 3913 3921 3923 3945 3953 3961 3963 4001 4009 4007 4002 4003 4004 4040 4040 4040	3562 3570 3578 2 3842 3850 3858 3866 3874 3982 3930 3938 3934 3954 3954 3954 3954 4040 4040 4040 4040 4058	3 3 3843 3851 3859 3867 3875 3883 3891 3995 3993 3995 3995 3995 4003 3997 4014 4019 4027 4035 4043 4045 4045	3572 3580 4 3844 3852 3860 3868 3876 3982 3990 3918 3918 3958 3958 3958 3958 4004 4012 4020 4028 4038 4045 4045 40460	3565 3573 3581 5 3845 3853 3861 3869 3877 3985 3997 4095 4013 4021 4028 4037 4045 4045 4061	3574 3582 6 3846 3854 3862 3870 3878 3986 3998 3998 3998 4006 4014 4030 4038 4046 4054 4062	3575 3583 7 3847 3855 3863 3879 3897 3993 3991 3913 3951 3957 3953 3953 3954 3954 3957 3957 4007 4015 4023 4031 4031 4047 4056 4083 4071 4079
to to 7777 4095	7000 7010 7020 7030 7040 7050 7060 7070 7110 7120 7130 7140 7150 7160 7210 7220 7230 7240 7250 7260 7270 7310 7320 7330 7340	3312 3320 0 3584 3592 3600 3616 3624 3632 3640 3658 3658 3672 3680 3704 3712 3728 3720 3728 3736 3744 3752 3760 3768 37768	3313 3321 1 3585 3593 3601 3633 3641 3649 3657 3673 3673 3705 3713 3721 3729 3737 3745 3753 3785 3793 3793 3809	3314 3322 2 3586 3594 3602 3618 3626 3634 3650 3658 3682 3698 3708 3714 3722 3730 3748 3754 3778 3778 3784 3810	3315 3323 3587 3595 3603 3635 3643 3651 3659 3675 3675 3675 3675 3779 3715 3723 3731 3747 3753 3771 3779 3787 3793 3793 3793 3793 3793 3793	3316 3324 4 3588 3496 3604 3620 3628 3636 3636 3636 3636 3700 3716 3724 3732 3740 3758 3764 3764 3772 3780 3788 3788 3788 3788 3788 3788 3788	3317 3325 5 3589 3497 3605 3637 3645 3663 3661 3663 3677 3875 3791 3717 3718 3719 3717 3718 3718 3718 3718 3718 3718 3718	3310 3318 3326 6 3590 3598 3614 3622 3638 3646 3654 3678 3678 3688 3694 3774 3718 3728 3734 3750 3758 3774 3782 3790 3798 3782	3311 3319 3327 7 3591 3599 3607 3615 3623 3639 3647 3679 3687 3679 3711 3719 3727 3735 3743 3751 3767 3775 3783 3791 3793 3791 3793 3793 3793 3815		7400 7410 7410 7410 7410 7410 7420 7430 7440 7550 7550 7550 7550 7560 7570 7660 7670 7680 7680 7680 7680 7680 76	3560 3568 3576 0 3840 3848 3848 3856 3864 3872 3912 3928 3928 3934 3942 3946 3952 3960 3968 3976 3984 4000 4002 4040 4040 4040 4048 4048	3561 3569 3577 1 3841 3849 3857 3865 3873 3983 3993 3913 3929 3937 3945 3953 3961 3969 3977 3985 3961 4001 4009 4009 4004 4044 4049 4044 4049 4045 4046	3562 3570 3578 2 3842 3850 3858 3866 3874 3914 3930 3914 3930 3938 3945 3956 3970 3978 3988 4002 4010 4010 4028 4058 4058 4068	3571 3579 3 3843 3851 3853 3867 3875 3893 3907 3915 3923 3939 3947 3953 3963 3971 3978 3989 4003 4014 4027 4035 4043 4051 4065	3572 3580 4 3844 3852 3860 3876 3996 3916 3924 3939 3940 3948 3948 3984 3984 4014 4012 4028 4024 4026 4044 4052 4058	3565 3573 3581 5 3845 3853 3869 3877 3985 3993 3997 3993 3997 4005 4013 4029 4037 4045 4053 4068	3574 3582 66 3846 3854 3862 3878 3894 3990 3910 3918 3924 3950 3958 3958 3958 4008 4014 4042 4040 4054 4064 4064 4064 4070	3875 3583 7 3847 3863 3863 3863 3895 3993 3993 3993 3993 3995 3993 3995 3993 3995 3998 3997 3998 3998 3998 4007 4015 4023 4047 4056 4068 4068 4071

TABLE 1A-3. OCTAL-DECIMAL FRACTION CONVERSION TABLE (SHEET 1 OF 3)

OCTAL	DEC.	OCTAL	DEC.	OCTAL	DEC.	OCTAL	DEC.
.000	.000000	.100	125000	.200	.250000	.300	.375000
.001	.001953	.101	.126953				
.002				.201	.251953	.301	.376953
	.003906	.102	.128906	.202	.253906	.302	.378906
.003	.005859	.103	.130859	.203	.255859	303	.380859
.004	.007812	.104	.132812	.204	.257812	.304	.382812
.005	.009765	.105	.134765				
.006				205	.259765	305	384765
	.011718	.106	.136718	.206	.261718	.306	.386718
.007	.013671	.107	138671	.207	263671	.307	.388671
.010	.015625	.110	.140625	.210	265625	.310	.390625
.011	.017578	.111	.142578	.211	267578		
.012	.019531	.112				.311	.392578
.013			.144531	.212	.269531	.312	.394531
	.021484	.113	146484	.213	.271484.	.313	.396484
.014	.023437	.114	.148437	.214	.273437	.314	.398437
.015	.025390	.115	150390	.215	.275390	.315	400390
.016	.027343	.116	.152343	.216	.277343	316	
.017	.029296	.117					.402343
.017	.023230	.'''	.154296	.217	.279296	.317	.404296
.020	.031250	.120	.156250	.220	.281250	.320	406250
.021	.033203	.121	158203	.221	283203	.321	408203
.022	.035156	.122	.160156				
.023	.037109			.222	.285156	.322	410156
		.123	.162109	.223	.287109	.323	.412109
.024	.039062	.124	.164062	.224	.289062	.324	414062
.025	.041015	.125	.166015	.225	.291015	.325	416015
.026	042968	.126	167968	226			
.027	.044921	.126	.169921	.226	.292968 .294921	.326 .327	.417968 .419921
						.321	.413321
.030	.046875	.130	.171875	.230	.296875	.330	.421875
.031	.048828	.131	.173828	.231	.298828	.331	.423828
.032	.050781	.132	.175781	232	.300781	.332	.425781
.033	052734	.133	.177734	233			
.034	.054687				.302734	.333	.427734
		.134	.179687	.234	.304687	.334	.429687
.035	.056640	.135	.181640	.235	.306640	.335	.431640
.036	.058593	.136	.183593	.236	.308593	.336	433593
.037	060546	.137	.185546	.237	310546	.337	.435546
.040	.062500	.140	107500				
.041			.187500	.240	.312500	.340	437500
	.064453	.141	.18 9453	.241	.314453	.341	.439453
.042	.066406	.142	.191 406	.242	.316406	.342	.441406
.043	.068359	.143	.193359	.243	318359	343	443359
.044	.070312	.144	195312				
.045				.244	.320312	.344	445312
	072265	.145	197265	.245	.322265	.345	447265
.046	.074218	.146	.199218	.246	.324218	.346	449218
.047	.076171	.147	.201171	.247	326171	.347	.451171
.050	.078125	.150	.203125	050	200125		
.051	.080078	.151	.205078	.250 .251	.328125	350	453125
.052	.082031				.330078	.351	455078
		.152	.207031	.252	.332031	.352	.457031
.053	.083984	.153	.208984	.253	.333984	.353	458984
.054	.085937	.154	.210937	.254	.335937	354	460937
.055	087890	.155	212890	.255	.337890	.355	462890
.056	.089843	.156				Į.	
.057			214843	.256	339843	.356	464843
.007	.091796	.157	.216796	.257	341796	.357	.466796
.060	.093750	.160	.218750	260	.343750	.360	.468750
.061	.095703	.161	.220703	.261	.345703		
.062	.097656					.361	470703
		.162	.222656	.262	347656	362	.472656
.063	099609	.163	224609	.263	.349609	363	474609
.064	101562	.164	.226562	264	.351562	.364	476562
.065	.103515	.165	228515	265	353515	365	478515
.066	105468	.166	230468	266			
067	.107421	.167	232421	267	.355468 .357421	.366 .367	480468 482421
						.30/	482421
.070	.109375	170	234375	.270	.359375	.370	.484375
.071	111328	.171	.236328	.271	.361328	.371	486328
.072	113281	.172	.238281	.272	.363281	.372	488281
.073	.115234	.173	240234	273			
	117187				.365234	.373	490234
074	-11/10/	.174	.242187	.274	.367187	.374	492187
.074		and the second s					
.075	.119140	.175	.244140	.275	.369140		494140
		.175 .176	.244140 .246093	.275 .276	.369140 .371093	.375 .376	

TABLE 1A-3. OCTAL-DECIMAL FRACTION CONVERSION TABLE (SHEET 2 OF 3)

,			1 1 2				
OCTAL	DEC.	OCTAL	DEC.	OCTAL	DEC.	OCTAL	DEC.
.000400	.000976	.000500	.001220	.000600	.001464	.000700	.001708
.000401	.000980	.000501	.001224	.000601	.001468	.000701	.001712
.000401	.000984	.000501	.001224	.000602	.001472	.000701	.001712
.000403	000988	.000502	.001232	.000602	.001472	.000702	.001710
.000404	.000991	.000504	.001232	.000604	.001470	.000703	.001724
.000405	.000995	.000505	001239	.000605	.001483	.000705	.001728
.000406	.000999	.000506	.001243	.000606	.001487	.000706	.001723
.000407	.001003	.000507	.001247	.000607	.001491	.000707	.001735
					.001101	.000707	.00.700
.000410	.001007	.000510	.001251	.000610	.001495	.000710	.001739
.000411	.001010	.000511	.001255	.000611	.001499	.000711	.001743
.000412	.001014	.000512	.001258	.000612	.001502	.000712	.001747
.000413	.001018	.000513	.001262	.000613	.001506	.000713	.001750
.000414	.001022	.000514	.001266	.000614	.001510	.000714	.001754
.000415	.001026 .001029	.000515 .000516	.001270 .001274	.000615	.001514	.000715	.001758
.000418	.001029	.000516	.001274	.000616 .000617	.001518 .001522	.000716 .000717	.001762 .001766
.000417	.001033	.000317	.001277	.000817	.001522	.000717	.001766
.000420	.001037	.000520	.001281	.000620	.001525	.000720	.001770
.000421	.001041	.000521	.001285	.000621	.001529	.000721	.001773
.000422	.001045	.000522	.001289	.000622	.001533	.000722	.001777
.000423	.001049	.000523	.001293	.000623	.001537	.000723	.001781
.000424	.001052	.000524	.001296	.000624	.001541	.000724	.001785
.000425	.001056	.000525	.001300	.000625	.001544	.000725	.001789
.000426	.001060	.000526	.001304	.000626	.001548	.000726	.001792
.000427	.001064	.000527	.001308	.000627	.001552	.000727	.001796
.000430	.001068	.000530	.001312	.000630	.001556	.000730	.001800
.000431	.001071	.000531	.001316	.000631	.001560	.000731	.001804
.000432	.001075	.000532	.001319	.000632	.001564	.000732	.001808
.000433	.001079	.000533	.001323	.000633	.001567	.000733	.001811
.000434	.001083	.000534	.001327	.000634	.001571	.000734	.001815
.000435	.001087	.000535	.001331	.000635	.001575	.000735	.001819
.000436	.001091	.000536	.001335	.000636	.001579	.000736	.001823
.000437	.001094	.000537	.001338	.000637	.001583	.000737	.001827
.000440	.001098	.000540	.001342	.000640	.001586	.000740	.001831
.000441	.001102	000541	.001346	.000641	.001590	.000741	.001834
000442	.001106	000542	.001350	.000642	.001594	.000742	.001838
.000443	.001110	.000543	.001354	.000643	.001598	.000743	.001842
.000444	.001113	.000544	.001358	.000644	.001602	.000744	.001846
.000445	.001117	.000545	.001361	.000645	.001605	.000745	.001850
.000446	.001121	.00054€	.001365	.000646	.001609	.000746	.001853
.000447	.001125	.000547	.001369	.000647	.001613	.000747	.001857
.000450	.001129	.000550	.001373	.000650	.001617	.000750	.001861
.000451	.001123	000551	.001373	.000651	.001621	.000751	.001865
.000451	.001136	.000552	.001377	.000652	.001625	.000752	.001869
.000453	.001140	.000553	.001384	.000653	.001628	.000752	.001873
.000454	.001144	.000554	.001388	.000654	.001632	.000754	001876
.000455	.001148	.000555	.001392	.000655	.001636	.000755	.001880
.000456	.001152	.00055€	.001396	.000656	.001640	.000756	.001884
.000457	.001155	.000557	.001399	.000657	.001644	.000757	.001888
.000460	.001159	.000560	001403	.000660	.001647	.000760	.001892
.000460	.001163	.000561	.001403 .001407	.000661	.001651	.000761	.001892
.000462	.001163	.000562	.001407	.000662	.001655	.000761	.001899
.000463	001171	.000563	.001411	.000663	.001659	.000763	.001903
.000464	.001174	.000564	.001419	.000664	.001663	.000764	.001907
.000465	.001178	000565	.001422	000665	001667	.000765	.001911
.000466	001182	000566	.001426	.000666	.001670	.000766	001914
.000467	.001186	.000567	.001430	.000667	.001674	.000767	.001918
000470	001100	000270		000070	001870	000770	001000
.000470	.001190	.000570	.001434	.000670	001678	.000770	.001922
.000471	.001194 .001197	.000571 .000572	.001438	.000671	.001682	.000771	.001926
.000472	.001201	.000572	.001441 .001445	.000672 .000673	.001686 .001689	.000772 .000773	.001930
.000473	.001201	.000574		.000673	.001693	.000773	.001934
.000474	.001208	.000575	.001449 .001453	.000674	.001693	.000774	.001937
.000476	.001209	.000576	.001453	.000878	.001701	.000776	.001941
.000478	.001218	.000577	.001461	.000677	.001701	.000777	.001949
							.001343
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OCTAL	DEC.	OCTAL	DEC.	OCTAL	DEC.	OCTAL	DEC.
.000000	.000000	.000100	.000244	.000200	.000488	.000300	000722
.000001	.000003	.000101	.000247	.000201	.000492	.000300	.000732
.000002	.000007	.000102	.000251	.000202	.000495	.000301	.000736 .000740
.000003	.000011	.000103	.000255	.000202	.000499		
.000004	.000015	.000104	.000259	.000203	.000499	000303	.000743
.000005	.000019	.000105	.000263			.000304	.000747
.000006	.000022	.000106	.000263	.000205	.000507	.000305	.000751
.000007	.000022	.000108		.000206	.000511	.000306	.000755
		.000107	.000270	.000207	.000514	.000307	.000759
.000010 .000011	.000030	.000110	.000274	.000210	.000518	.000310	.000762
	.000034	.000111	.000278	.000211	.000522	.000311	.000766
.000012	.000038	.000112	.000282	.000212	.000526	.000312	.000770
.000013	.000041	.000113	.000286	.000213	.000530	.000313	.000774
.000014	.000045	.000114	.000289	.000214	.000534	.000314	.000778
.000015	.000049	.000115	.000293	.000215	.000537	.000315	.000782
.000016	.000053	.000116	.000297	.000216	.000541	.000316	.000785
.000017	.000057	.000117	.000301	.000217	.000545	.000317	.000789
.000020	.000061	.000120	.000305	.000220	.000549	000330	000702
.000021	.000064	.000120	000308			.000320	.000793
.000021	.000068	.000121		.000221	.000553	.000321	.000797
.000022	.000072		.000312	.000222	.000556	.000322	.000801
		.000123	.000316	.000223	.000560	.000323	.000805
.000024	.000076	.000124	.000320	.000224	.000564	.000324	.000808
.000025	.000080	.000125	.000324	.000225	.000568	.000325	.000812
.000026	.000083	.000126	.000328	.000226	.000572	.000326	.000816
.000027	.000087	.000127	.000331	.000227	.000576	.000327	.000820
.000030	.000091	.000130	.000335	.000230	.000579	.000330	.000823
.000031	.000095	.000131	.000339	.000231	.000583	.000330	.000823
.000032	000099	.000132	.000343	.000231	.000583		
.000033	.000102	.000132	.000343			.000332	.000831
.000034	.000102	.000133		.000233	.000591	.000333	.000835
.000035	.000100		.000350	.000234	.000595	.000334	.000839
		.000135	.000354	.000235	.000598	.000335	.000843
.000036 .000037	.000114 .000118	.000136 .000137	.000358	.000236	.000602	.000336	.000846
	.000116	.000137	.000362	.000237	.000606	.000337	.000850
.000040	.000122	.000140	.000366	.000240	.000610	.000340	.000854
.000041	.000125	.000141	.000370	.000241	.000614	.000341	.000858
.000042	.000129	.000142	.000373	.000242	.000617	.000342	.000862
.000043	.000133	.000143	.000377	.000243	.000621	.000343	.000865
.000044	.000137	.000144	.000381	.000244	.000625	.000344	.000869
.000045	.000141	.000145	.000385	.000245	.000629	.000344	
.000046	.000144	.000146	.000389	.000246	.000633		.000873
.000047	.000148	.000147	.000388	.000248	.000633	.000346	.000877 .000881
.000050	.000152	.000150	000200			ĺ	
.000051	.000152	.000150	.000396 .000400	.000250 .000251	.000640 .000644	.000350	.000885
.000052	.000160	.000151				.000351	.000888
.000053	.000160	.000152	.000404	.000252	.000648	.000352	.000892
.000054	.000167		.000408	.000253	.000652	.000353	.000896
.000055		.000154	.000411	.000254	.000656	.000354	.000900
	.000171	.000155	.000415	.000255	.000659	.000355	.000904
.000056	.000175	.000156	.000419	.000256	.000663	.000356	.000907
000057	.000179	.000157	.000423	.000257	.000667	.000357	.000911
.000060	.000183	.000160	.000427	.000260	.000671	.000360	.000915
.000061	.000186	.000161	.000431	.000261	.000675	.000361	.000919
.000062	.000190	.000162	.000434	.000262	.000679	.000362	
.000063	.000194	.000163	.000434	.000262	.000679		.000923
.000064	.000198	.000163	.000438	.000263		.000363	.000926
.000065	.000138	.000164			.000686	.000364	.000930
.000066	.000202		.000446	.000265	.000690	.000365	.000934
.000067	.000208	.000166 .000167	.000450 .000453	.000266	.000694 .000698	.000366	.000938
					.000008	.000367	.000942
.000070	.000213	.000170	.000457	.000270	.000701	.000370	.000946
.000071	.000217	.000171	.000461	.000271	.000705	.000371	.000949
.000072	.000221	.000172	.000465	.000272	.000709	.000372	.000953
.000073	.000225	.000173	.000469	.000273	.000713	.000373	.000957
	.000228	.000174	.000473	.000274	.000717	.000374	.000961
.000074	····						
.000074 .000075	.000232	.000175					
			.000476	.000275 .000276	.000720 .000724	.000375	.000965

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